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(54) **CENTRALIZED METHOD AND SYSTEM FOR DETERMINING VOICE COMMANDS**

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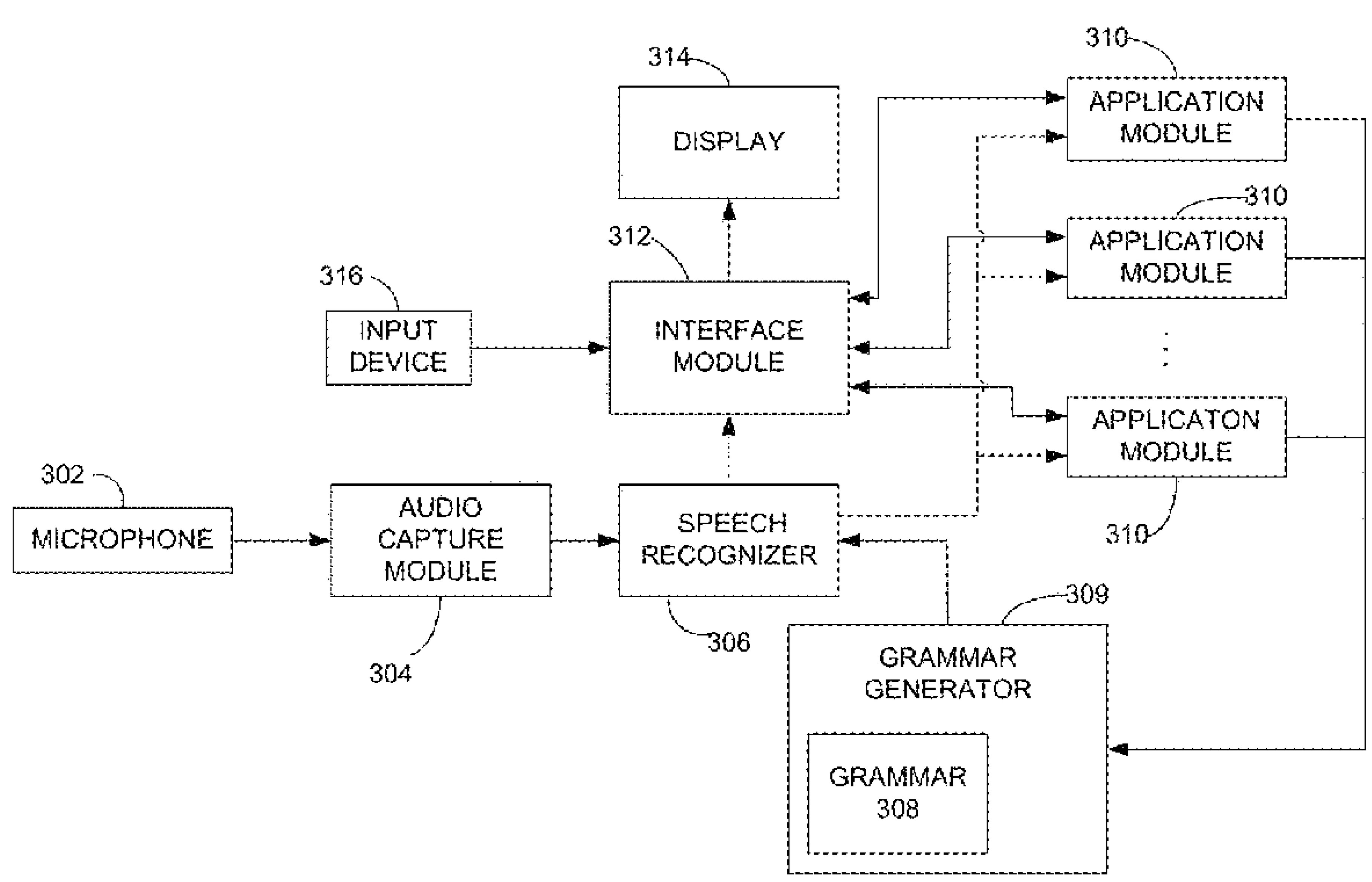
(57) **ABSTRACT**

A computing system includes at least one processor and memory storing instructions that, when executed, cause the computing system to receive an indication of a set of grammar commands for an application associated with the computing system, each grammar command corresponding to an executable command that is executable by the application to perform a corresponding application action, receive an indication of a first speech input, from a user, captured by a speech capture component, detect an ambiguity based on a correlation between the first speech input and the set of grammar commands, provide, to the user, an output that represents the detected ambiguity, receive, in response to the output, an indication of a second speech input that is captured by the speech capture component and resolves the ambiguity, and, based on the second speech input execute the executable command that corresponds to one of the grammar commands.

19 Claims, 14 Drawing Sheets



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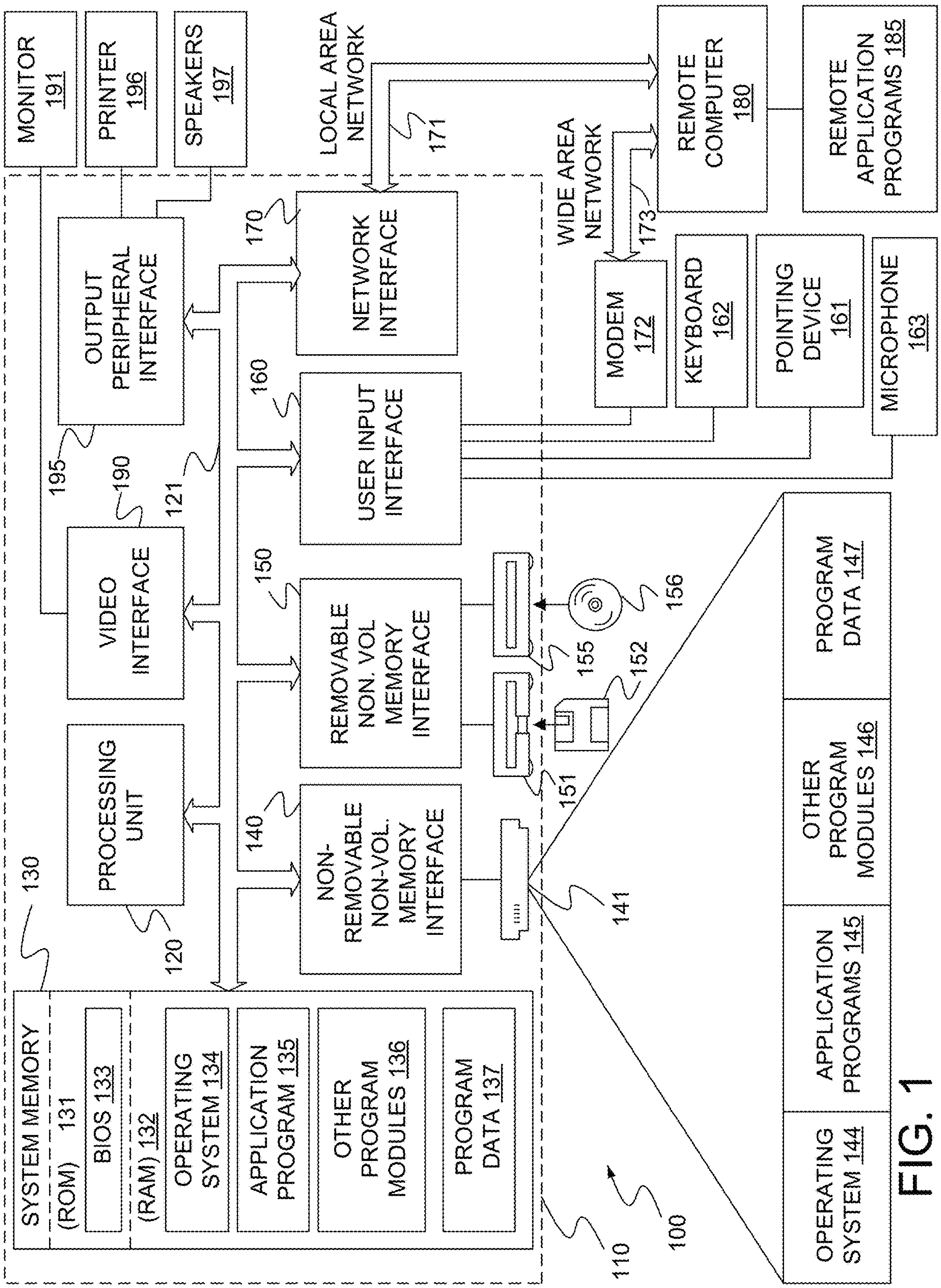

MONITOR 191
PRINTER 196
SPEAKERS 197
LOCAL AREA NETWORK
171
REMOTE COMPUTER 180
REMOTE APPLICATION PROGRAMS 185
WIDE AREA NETWORK
173
OUTPUT PERIPHERAL INTERFACE
195
190
121
VIDEO INTERFACE
170
NETWORK INTERFACE
160
USER INPUT INTERFACE
MODEM 172
KEYBOARD 162
POINTING DEVICE 161
MICROPHONE 163
130
PROCESSING UNIT
120
150
REMOVABLE NON. VOL MEMORY INTERFACE
140
NON-REMOVABLE NON-VOL. MEMORY INTERFACE
155
156
152
151
141
SYSTEM MEMORY
(ROM) 131
BIOS 133
(RAM) 132
OPERATING SYSTEM 134
APPLICATION PROGRAM 135
OTHER PROGRAM MODULES 136
PROGRAM DATA 137
110
100
OPERATING SYSTEM 144
APPLICATION PROGRAMS 145
OTHER PROGRAM MODULES 146
PROGRAM DATA 147

FIG. 1

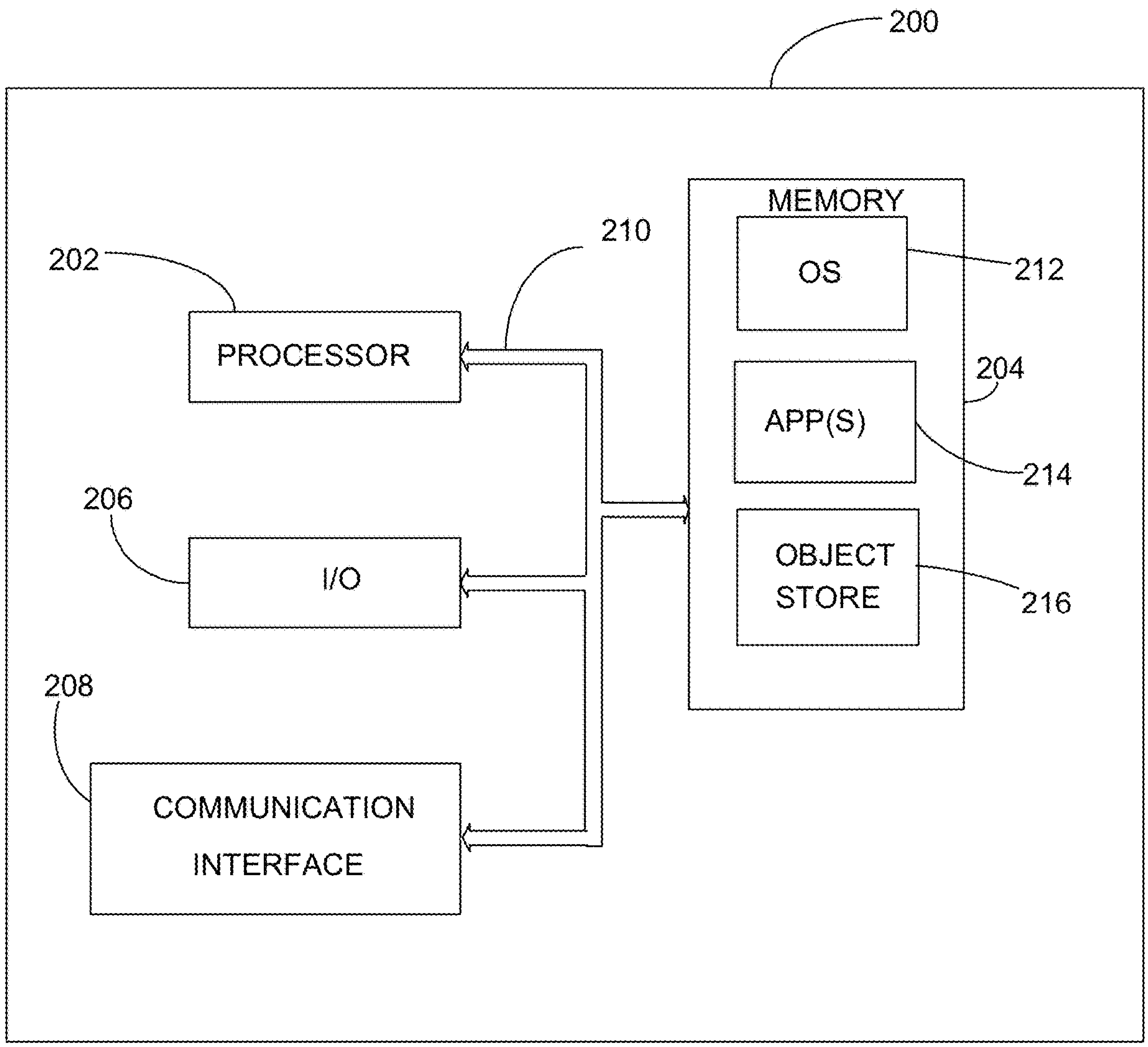
200
MEMORY
OS
212
210
202
PROCESSOR
204
APP(S)
214
206
I/O
OBJECT
STORE
216
208
COMMUNICATION
INTERFACE

FIG. 2

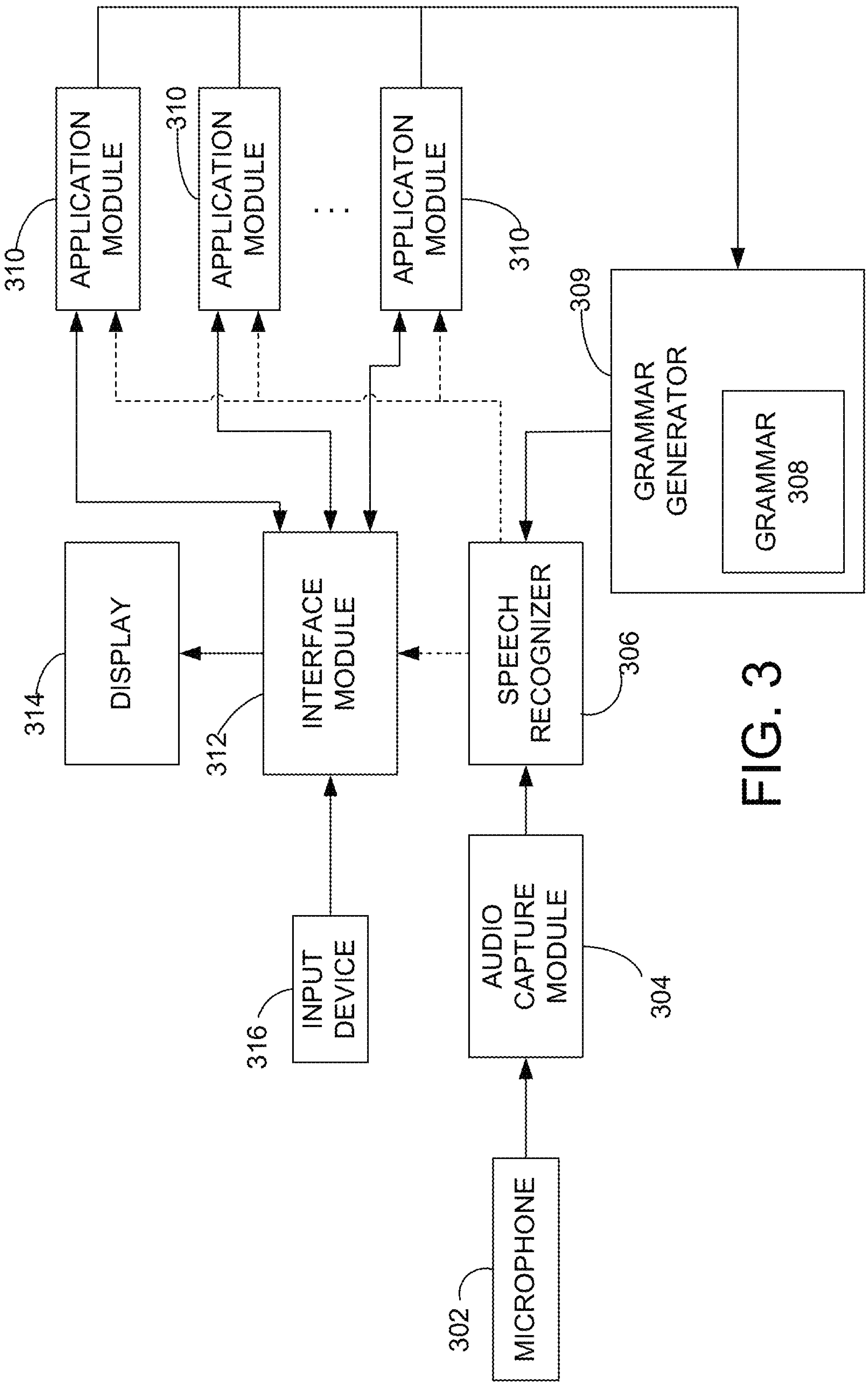
310
APPLICATION MODULE
310
APPLICATION MODULE
APPLICATON MODULE
310
309
GRAMMAR GENERATOR
GRAMMAR 308
314
DISPLAY
312
INTERFACE MODULE
SPEECH RECOGNIZER
306
316
INPUT DEVICE
AUDIO CAPTURE MODULE
304
302
MICROPHONE

FIG. 3

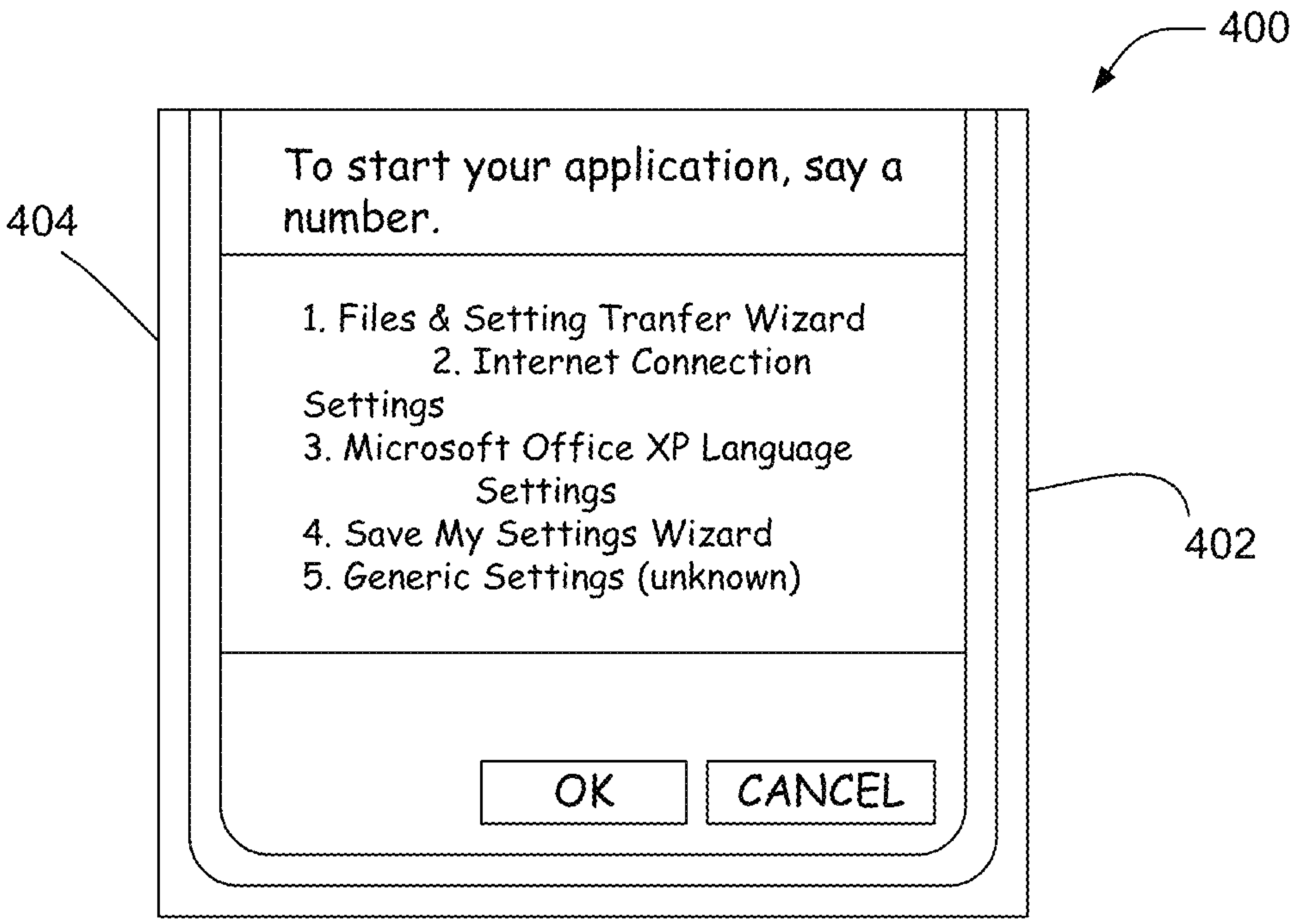
400
404
To start your application, say a number.
1. Files & Setting Tranfer Wizard
2. Internet Connection Settings
3. Microsoft Office XP Language Settings
4. Save My Settings Wizard
5. Generic Settings (unknown)
402
OK
CANCEL

FIG. 4

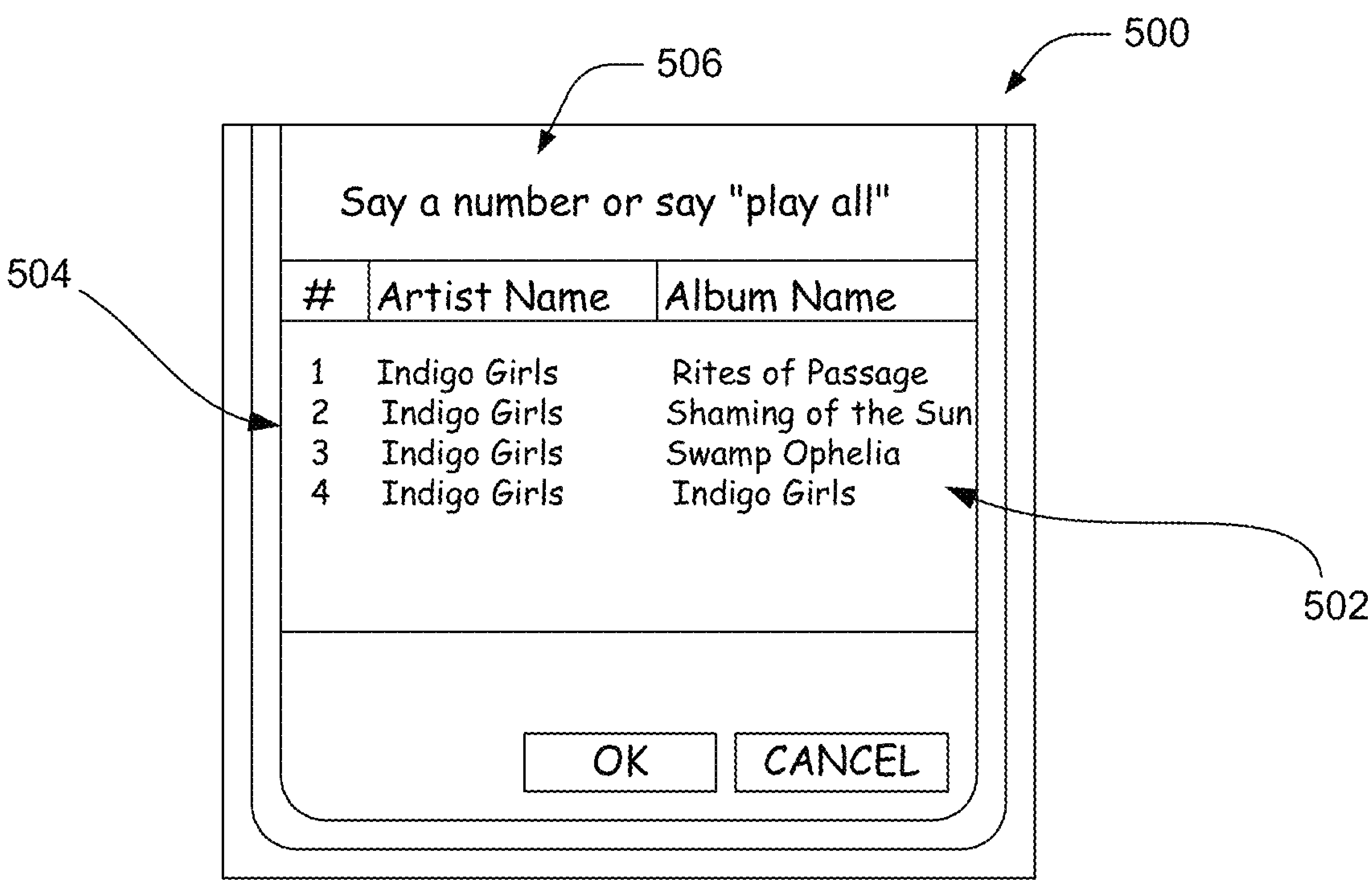
500
506
504
Say a number or say "play all"
Artist Name Album Name
1 Indigo Girls Rites of Passage
2 Indigo Girls Shaming of the Sun
3 Indigo Girls Swamp Ophelia
4 Indigo Girls Indigo Girls
502
OK
CANCEL

FIG. 5

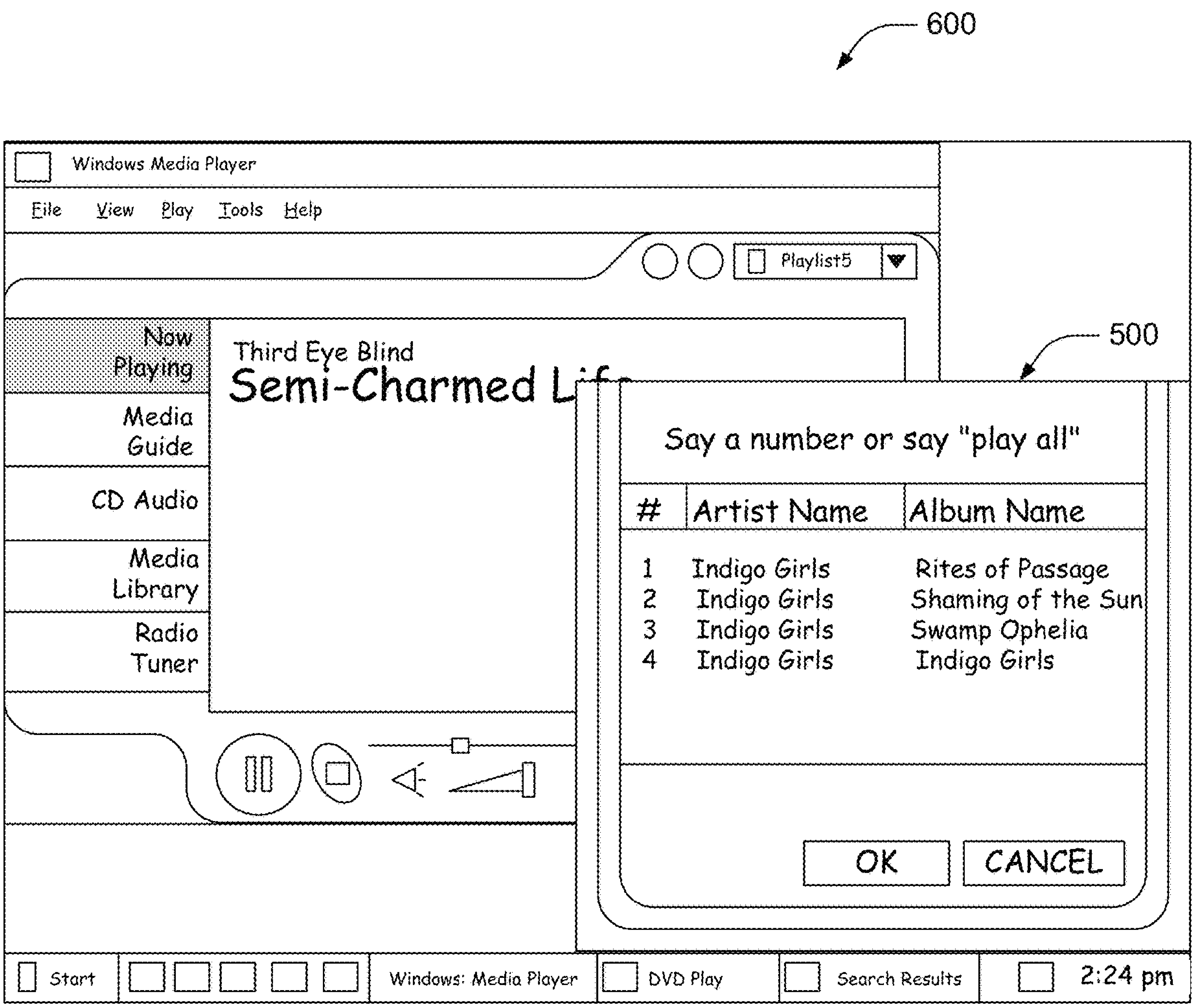
600
Windows Media Player
File View Play Tools Help
Playlist5
Now Playing
Media Guide
CD Audio
Media Library
Radio Tuner
Third Eye Blind
Semi-Charmed Lif
500
Say a number or say "play all"
Artist Name Album Name
1 Indigo Girls Rites of Passage
2 Indigo Girls Shaming of the Sun
3 Indigo Girls Swamp Ophelia
4 Indigo Girls Indigo Girls
OK
CANCEL
Start
Windows: Media Player
DVD Play
Search Results
2:24 pm

FIG. 6

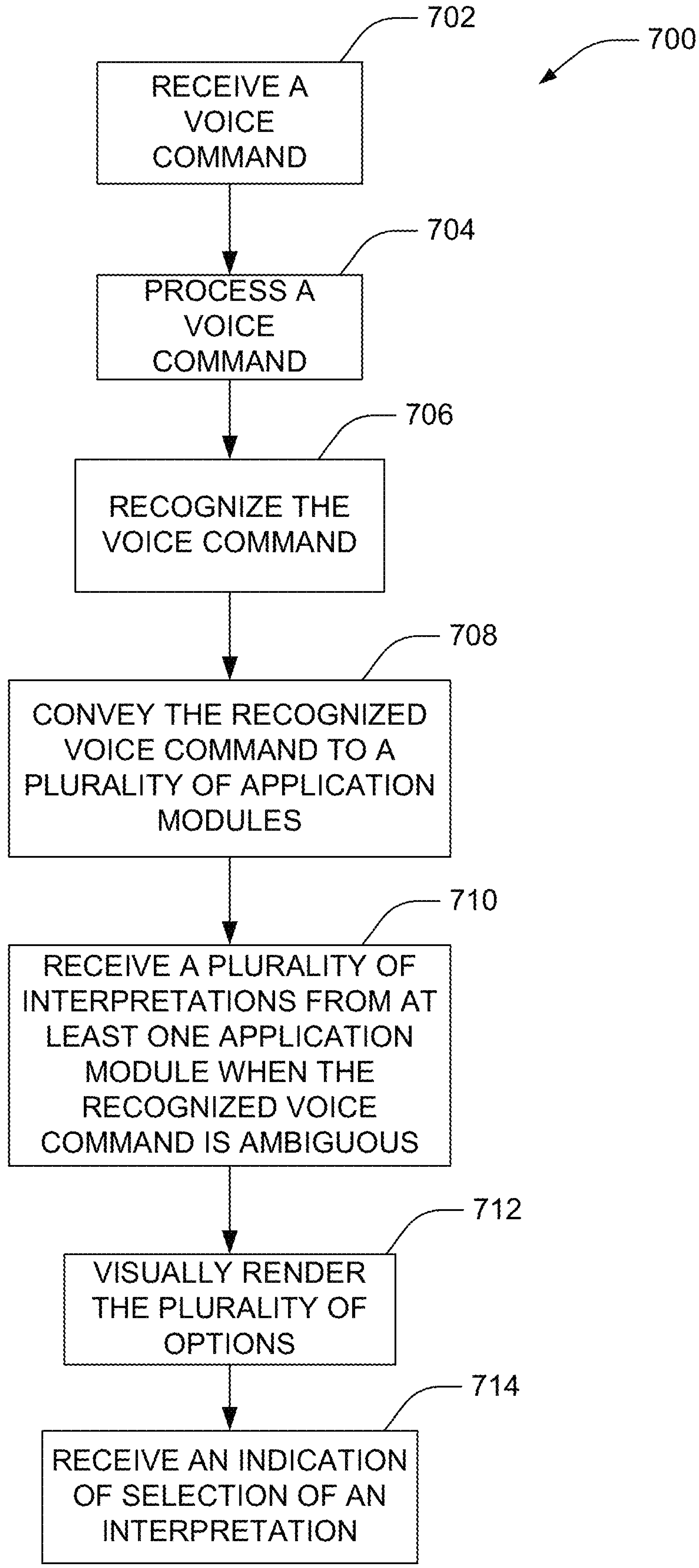
700
702
RECEIVE A VOICE COMMAND
704
PROCESS A VOICE COMMAND
706
RECOGNIZE THE VOICE COMMAND
708
CONVEY THE RECOGNIZED VOICE COMMAND TO A PLURALITY OF APPLICATION MODULES
710
RECEIVE A PLURALITY OF INTERPRETATIONS FROM AT LEAST ONE APPLICATION MODULE WHEN THE RECOGNIZED VOICE COMMAND IS AMBIGUOUS
712
VISUALLY RENDER THE PLURALITY OF OPTIONS
714
RECEIVE AN INDICATION OF SELECTION OF AN INTERPRETATION

FIG. 7

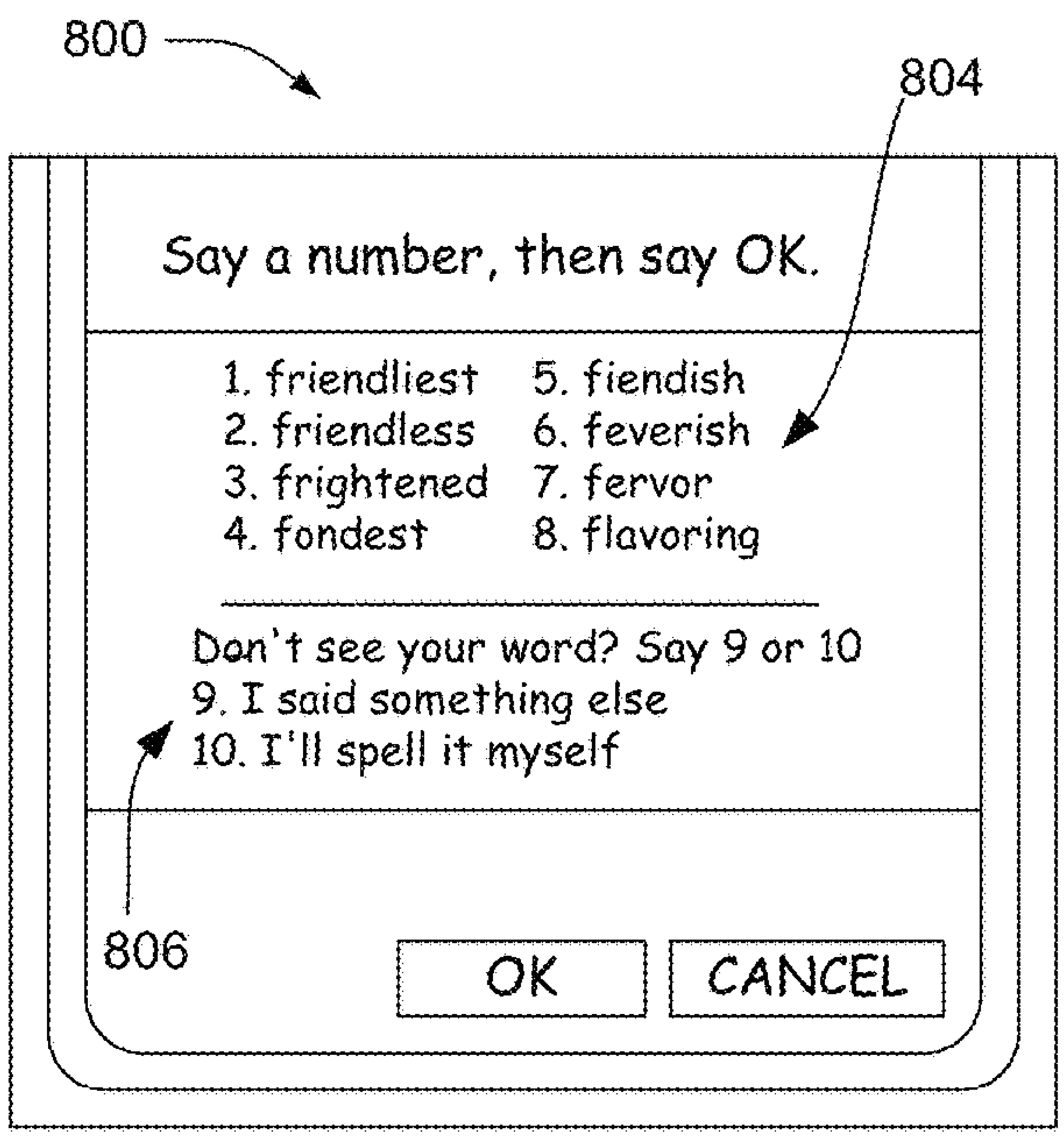

FIG. 8

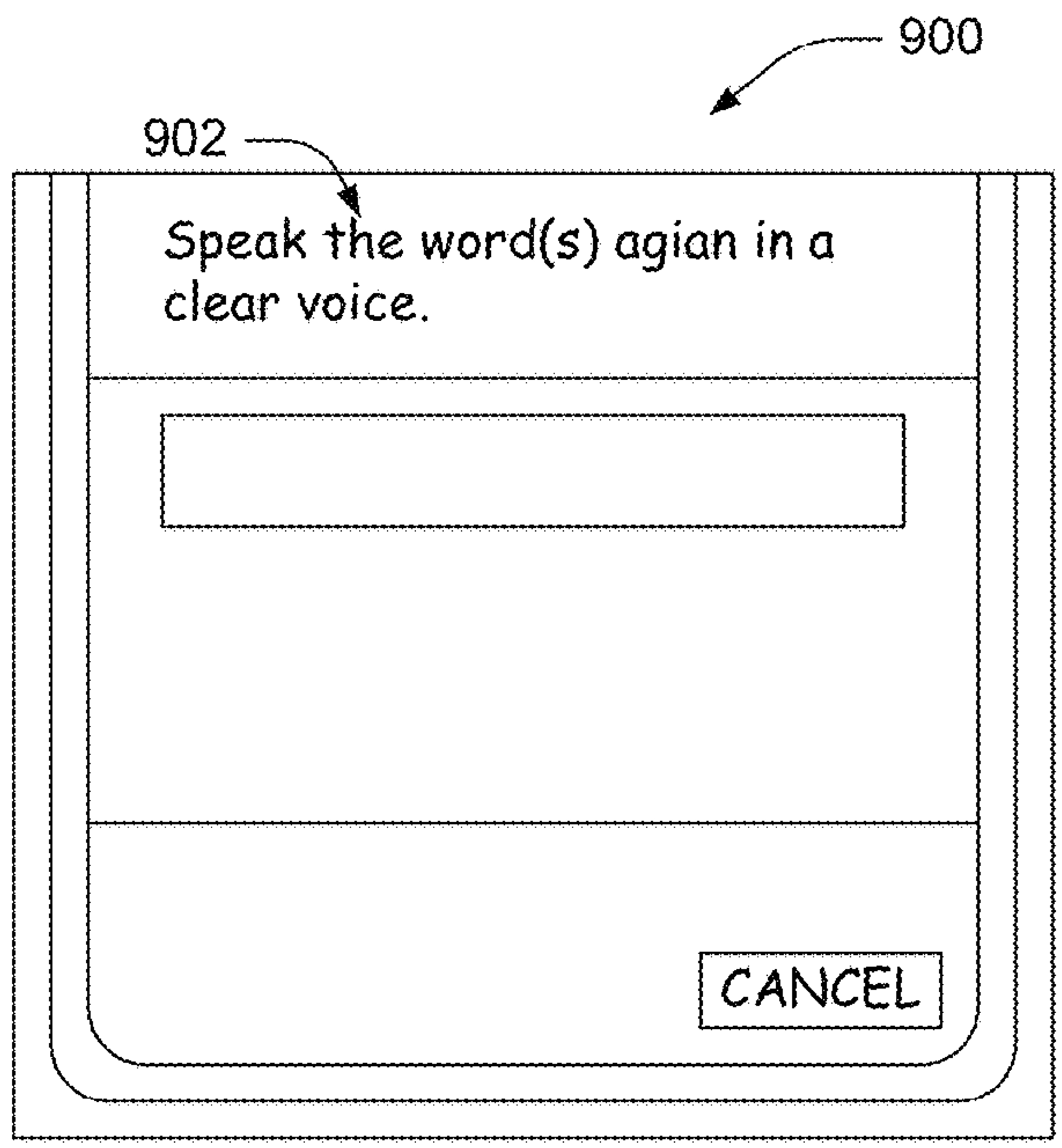

FIG. 9

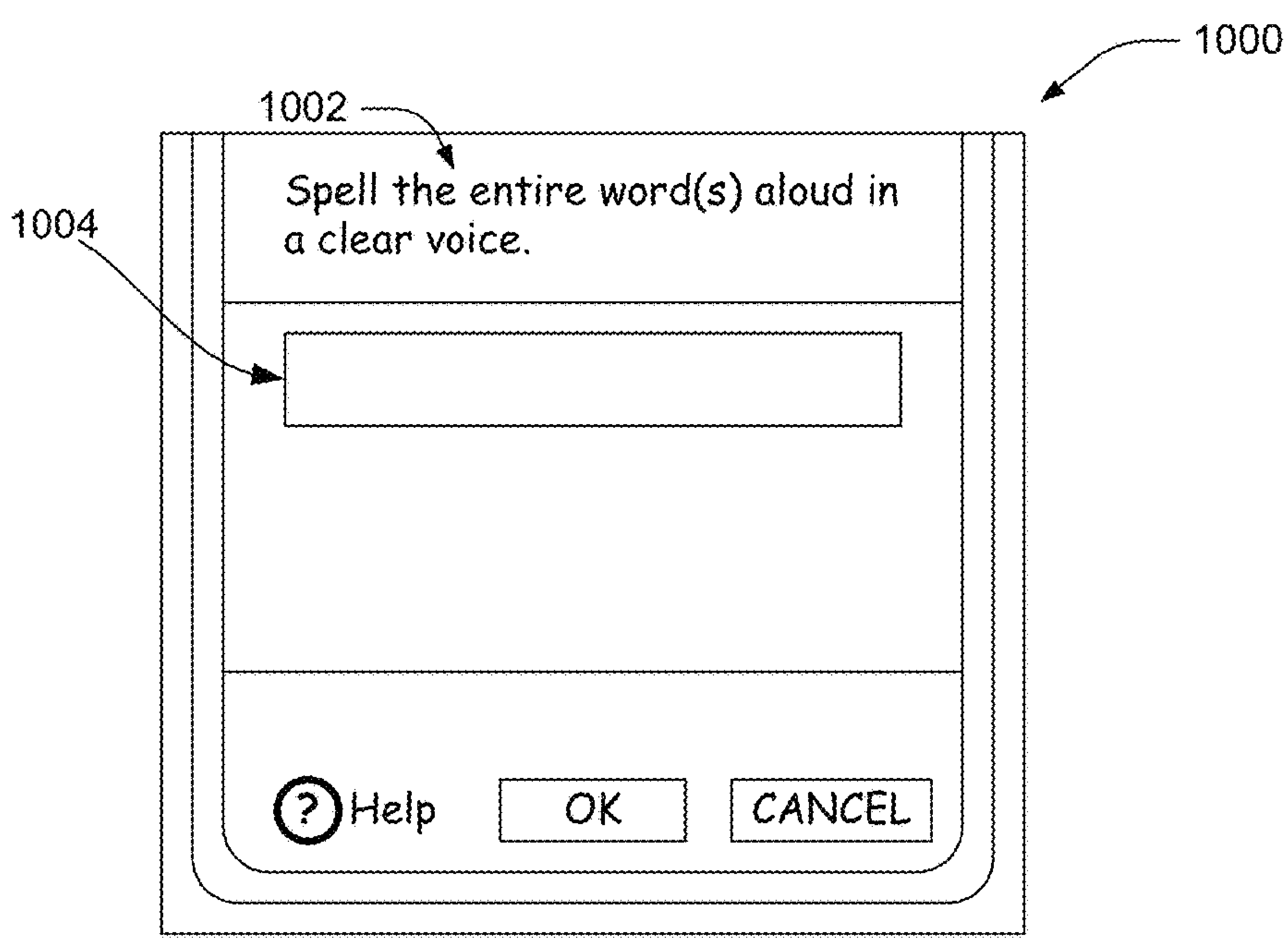

FIG. 10

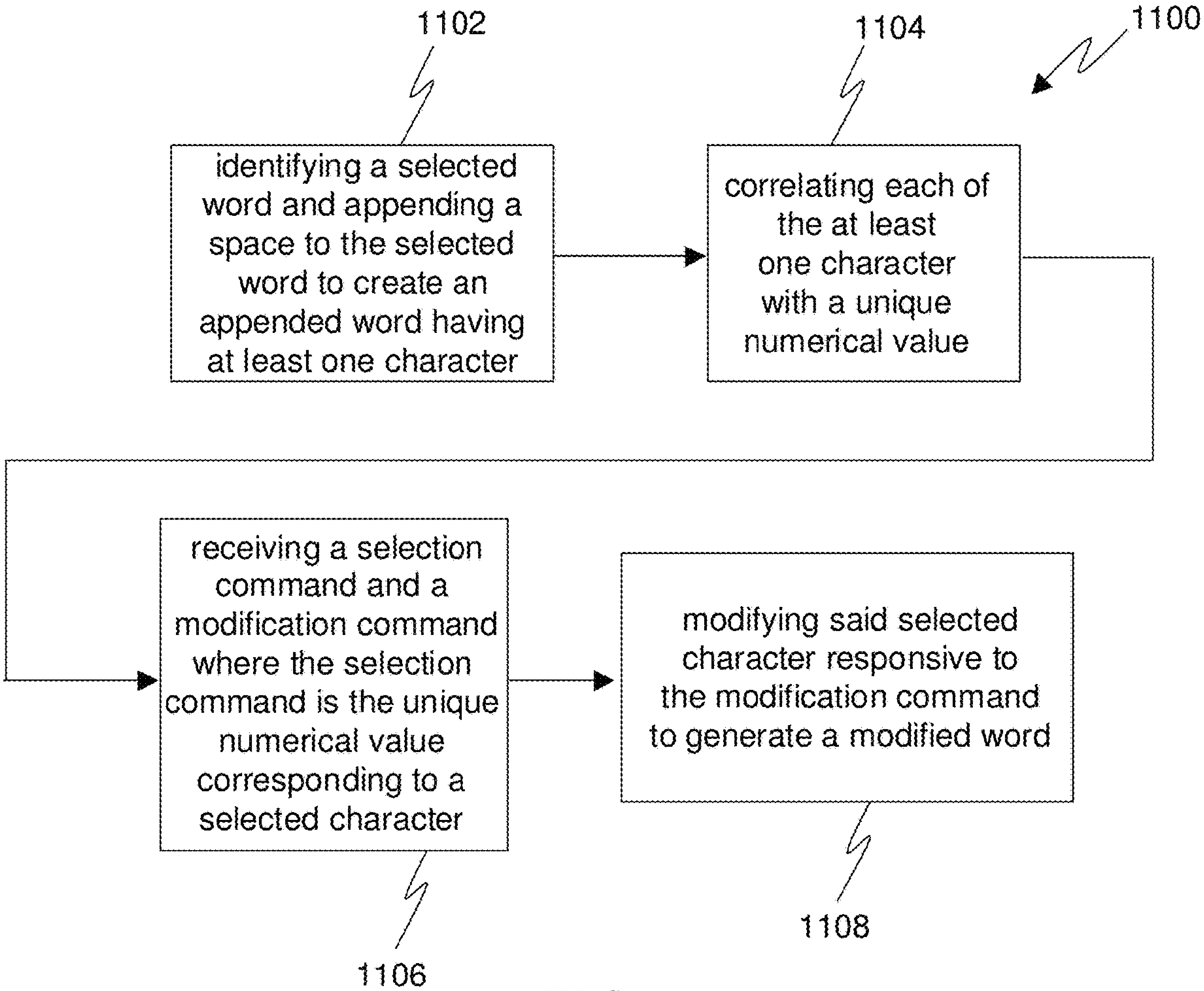
1100
1102
identifying a selected word and appending a space to the selected word to create an appended word having at least one character
1104
correlating each of the at least one character with a unique numerical value
receiving a selection command and a modification command where the selection command is the unique numerical value corresponding to a selected character
1106
modifying said selected character responsive to the modification command to generate a modified word
1108

FIG. 11

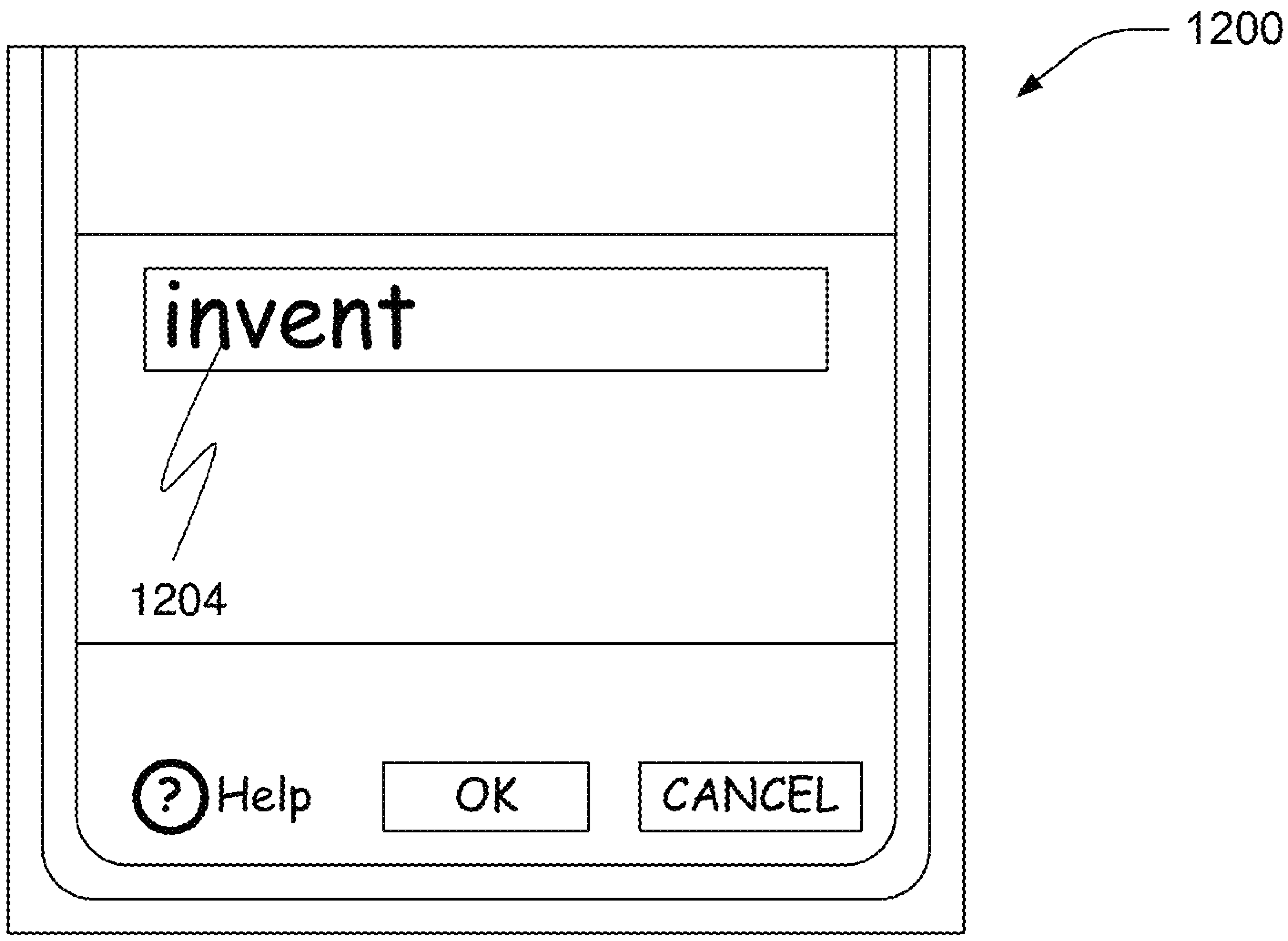
1200
invent
1204
Help
OK
CANCEL

FIG. 12

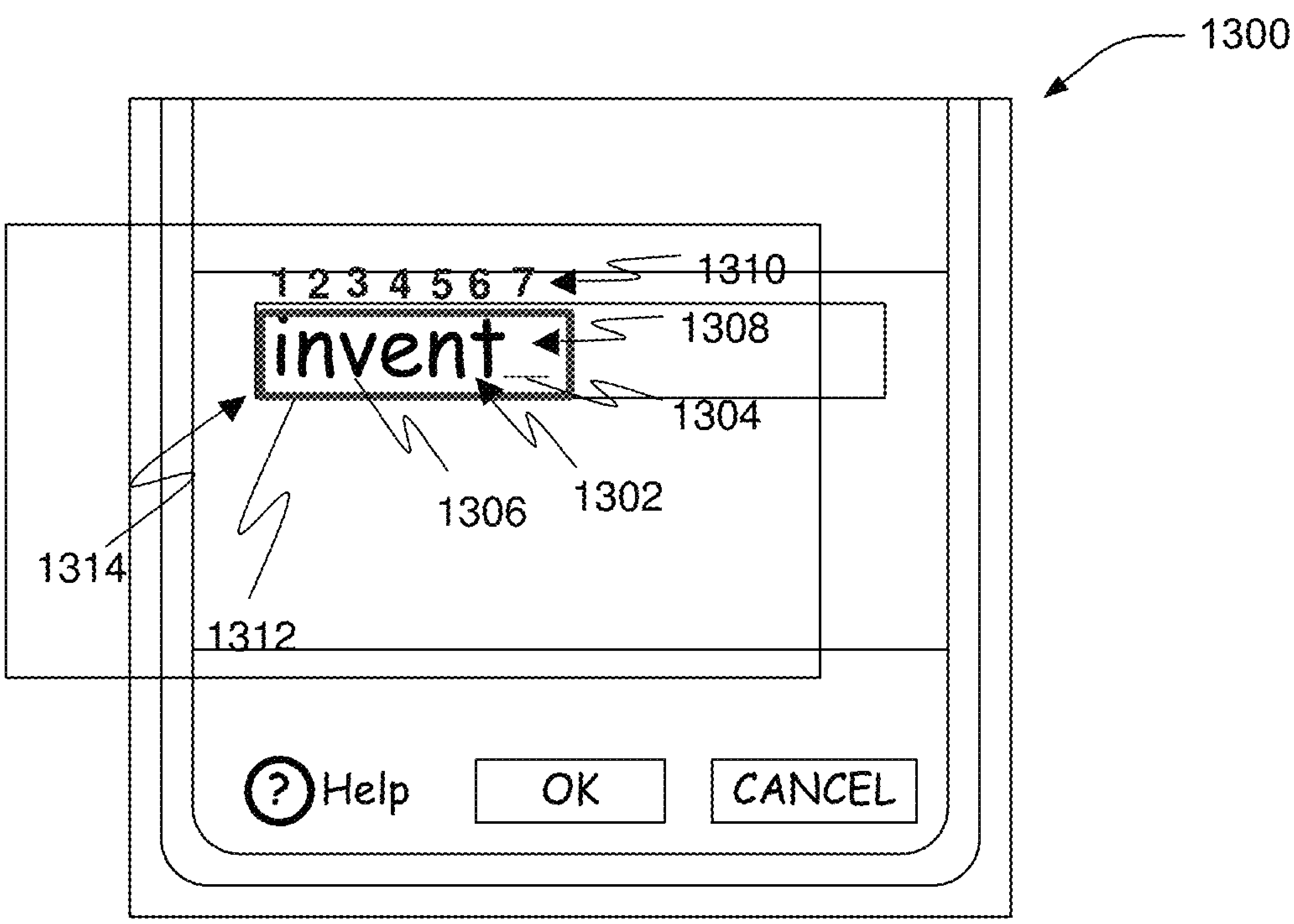
1300
1 2 3 4 5 6 7
1310
invent
1308
1304
1306
1302
1314
1312
Help
OK
CANCEL

FIG. 13

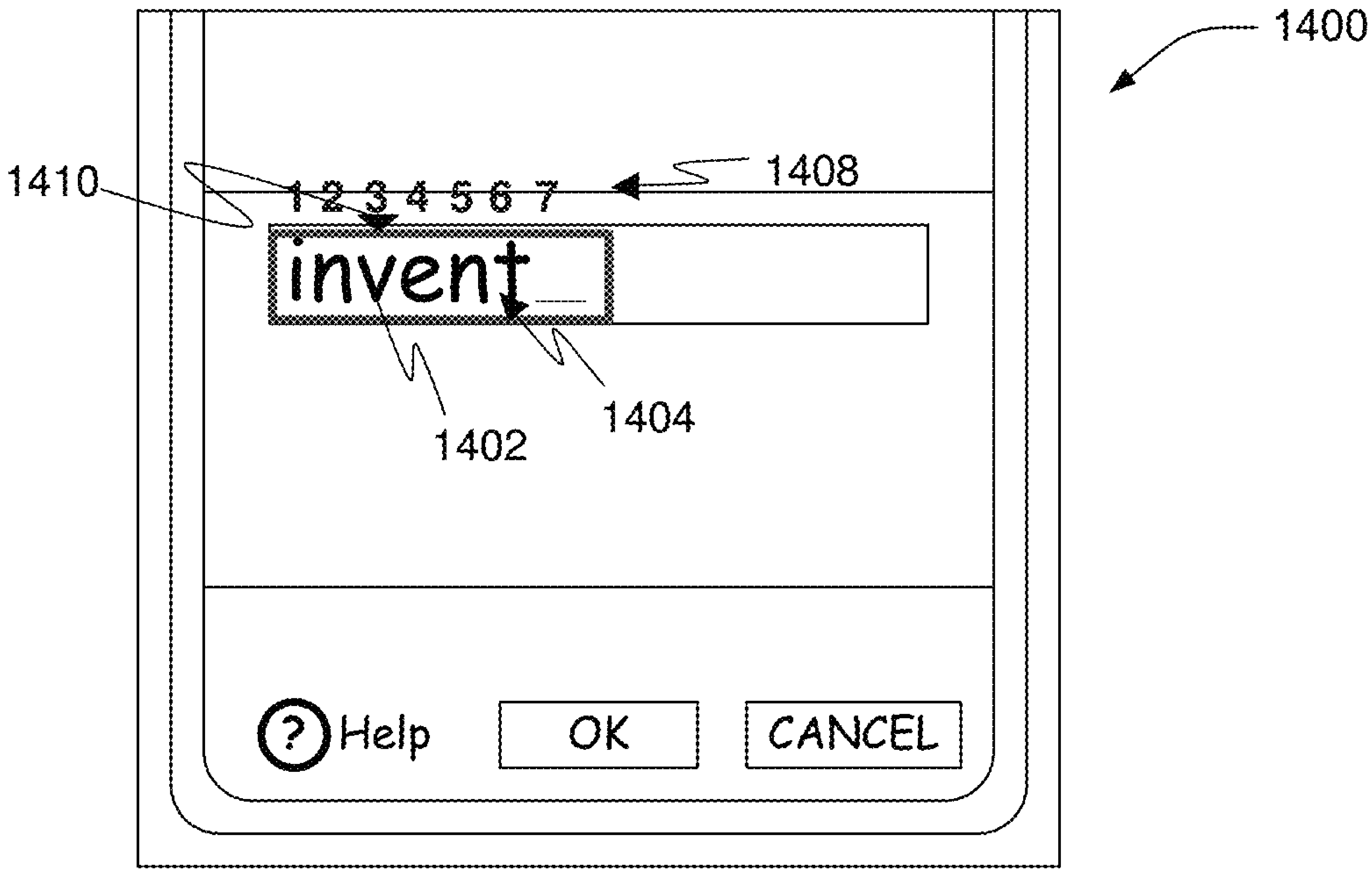
1400
1410
1 2 3 4 5 6 7
1408
invent_
1402
1404
Help
OK
CANCEL

FIG. 14

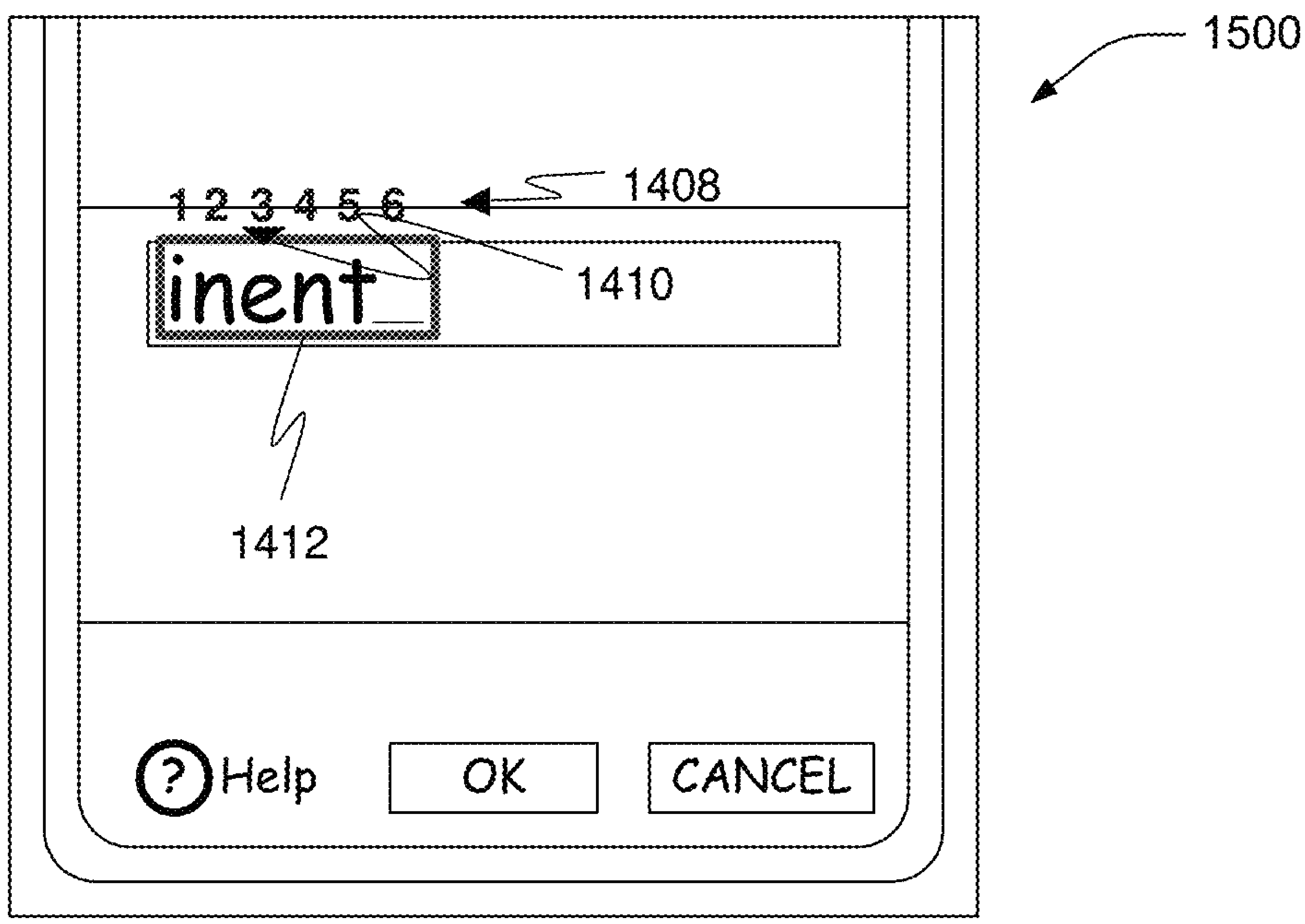
1500
1 2 3 4 5 6
1408
1410
inent_
1412
Help
OK
CANCEL

FIG. 15

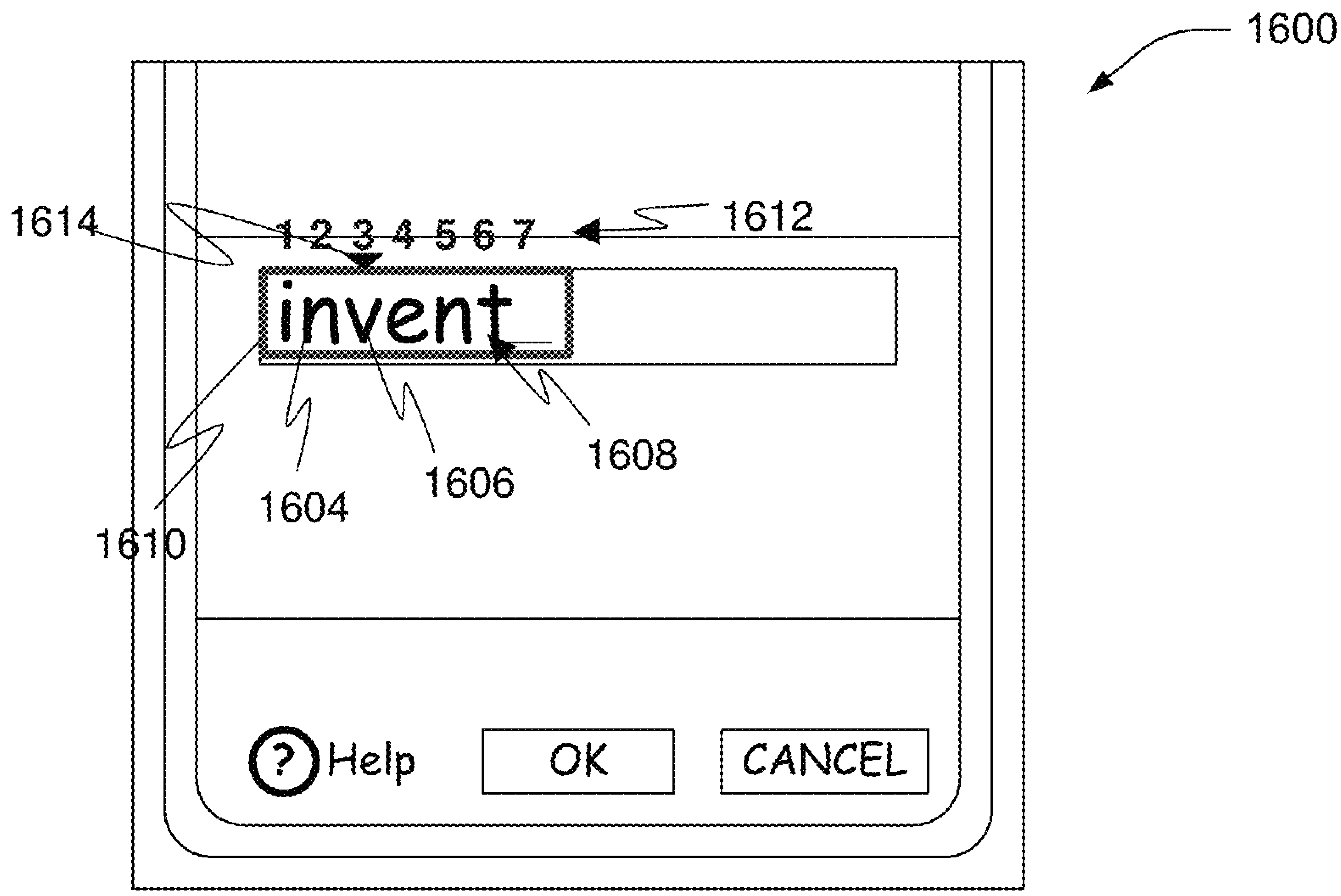
1600
1614
1 2 3 4 5 6 7
1612
invent
1604
1606
1608
1610
Help
OK
CANCEL

FIG. 16

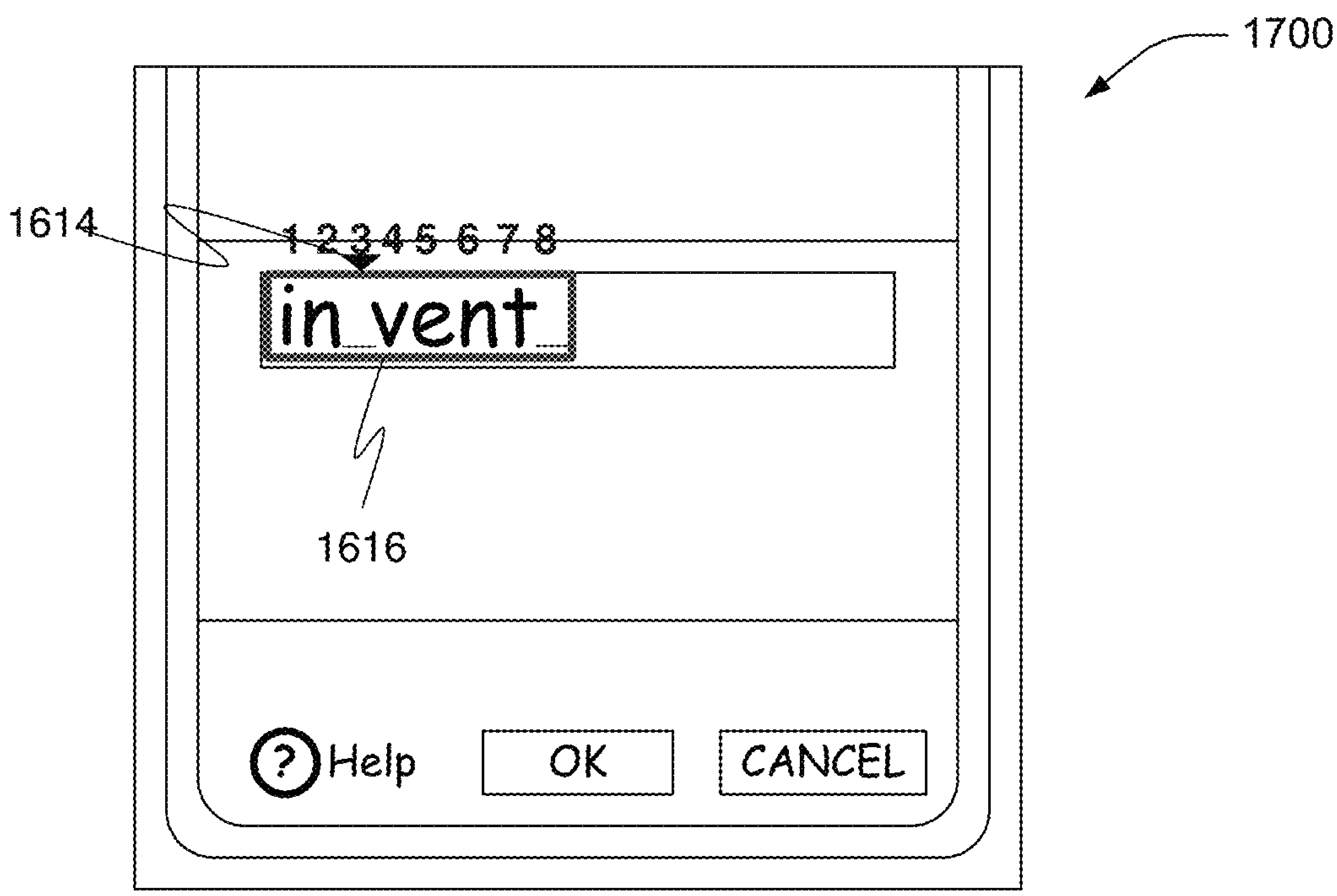
1700
1614
1 2 3 4 5 6 7 8
in vent
1616
Help
OK
CANCEL

FIG. 17

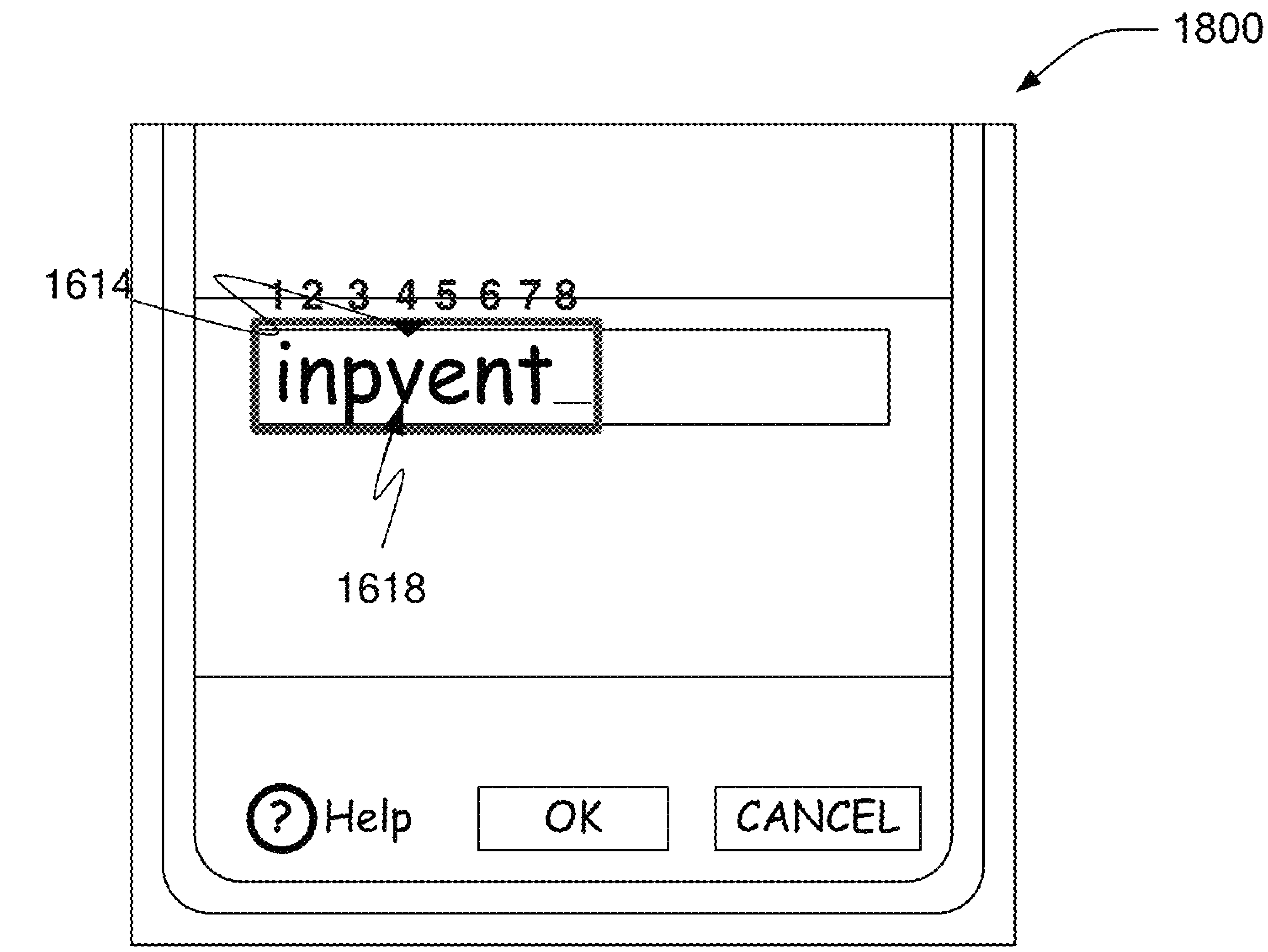
1800
1614
1 2 3 4 5 6 7 8
inpyent_
1618
Help
OK
CANCEL

FIG. 18

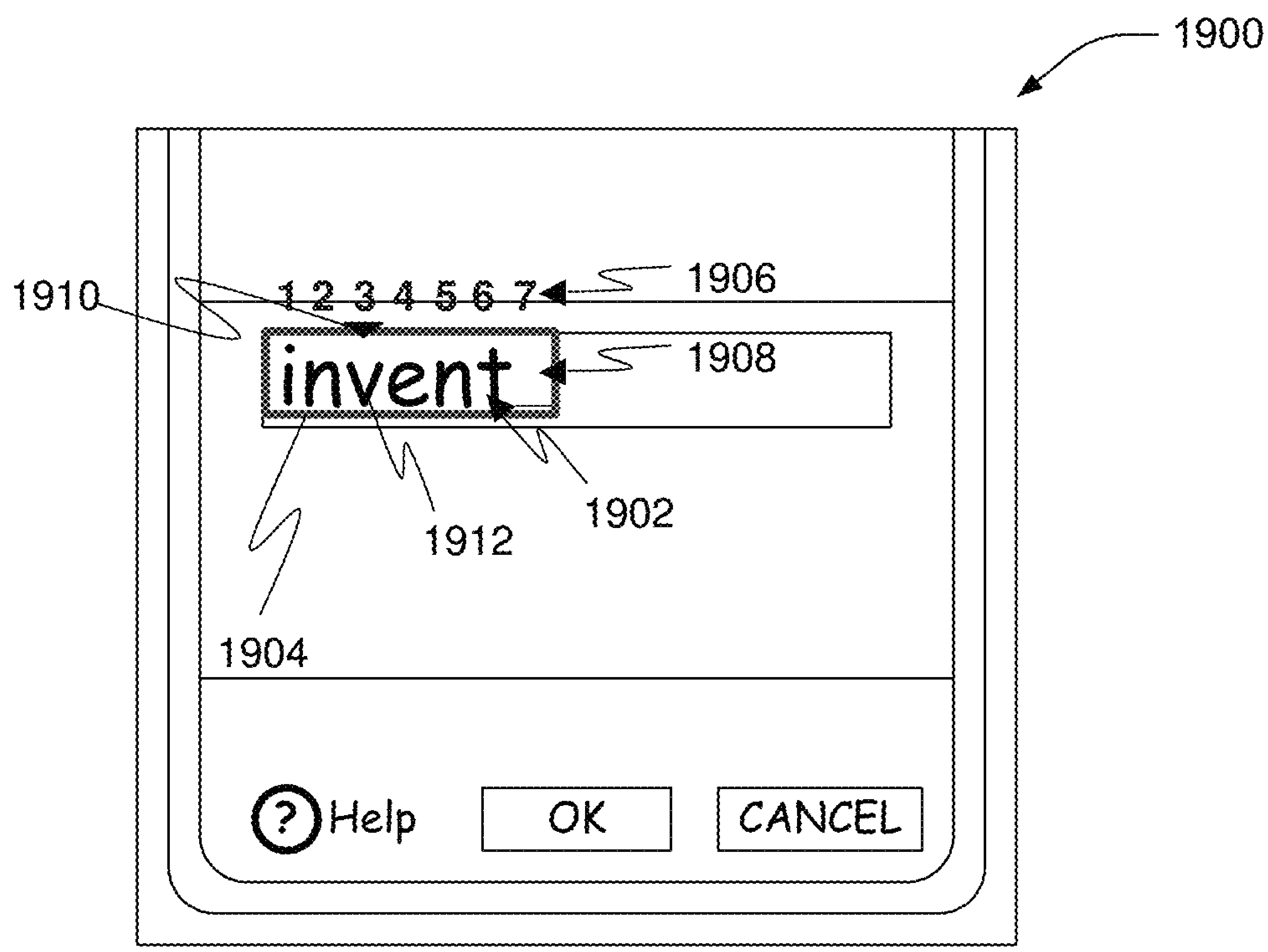
1900
1910
1 2 3 4 5 6 7
1906
invent
1908
1912
1902
1904
Help
OK
CANCEL

FIG. 19

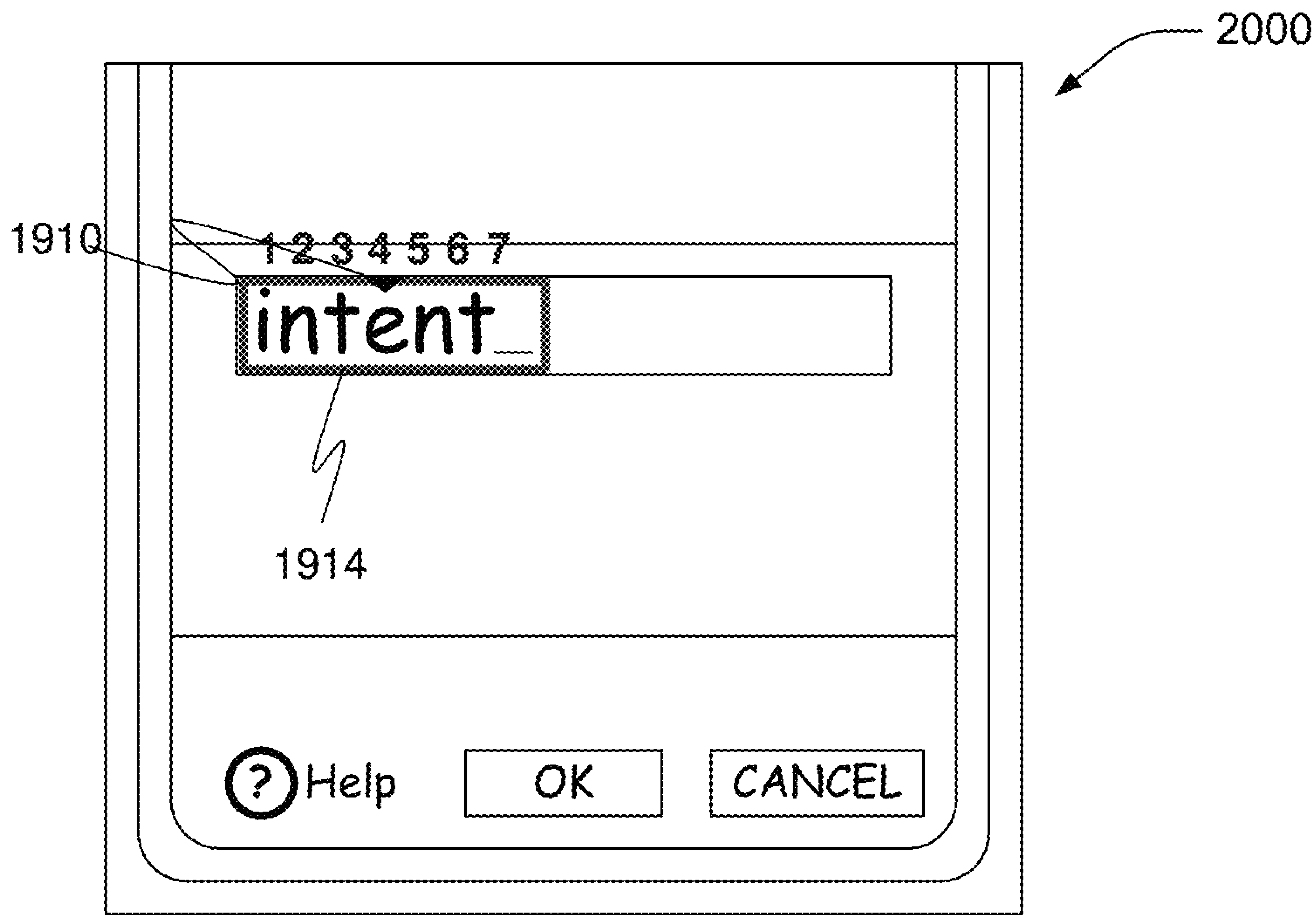
2000
1910
1 2 3 4 5 6 7
intent_
1914
Help
OK
CANCEL

FIG. 20

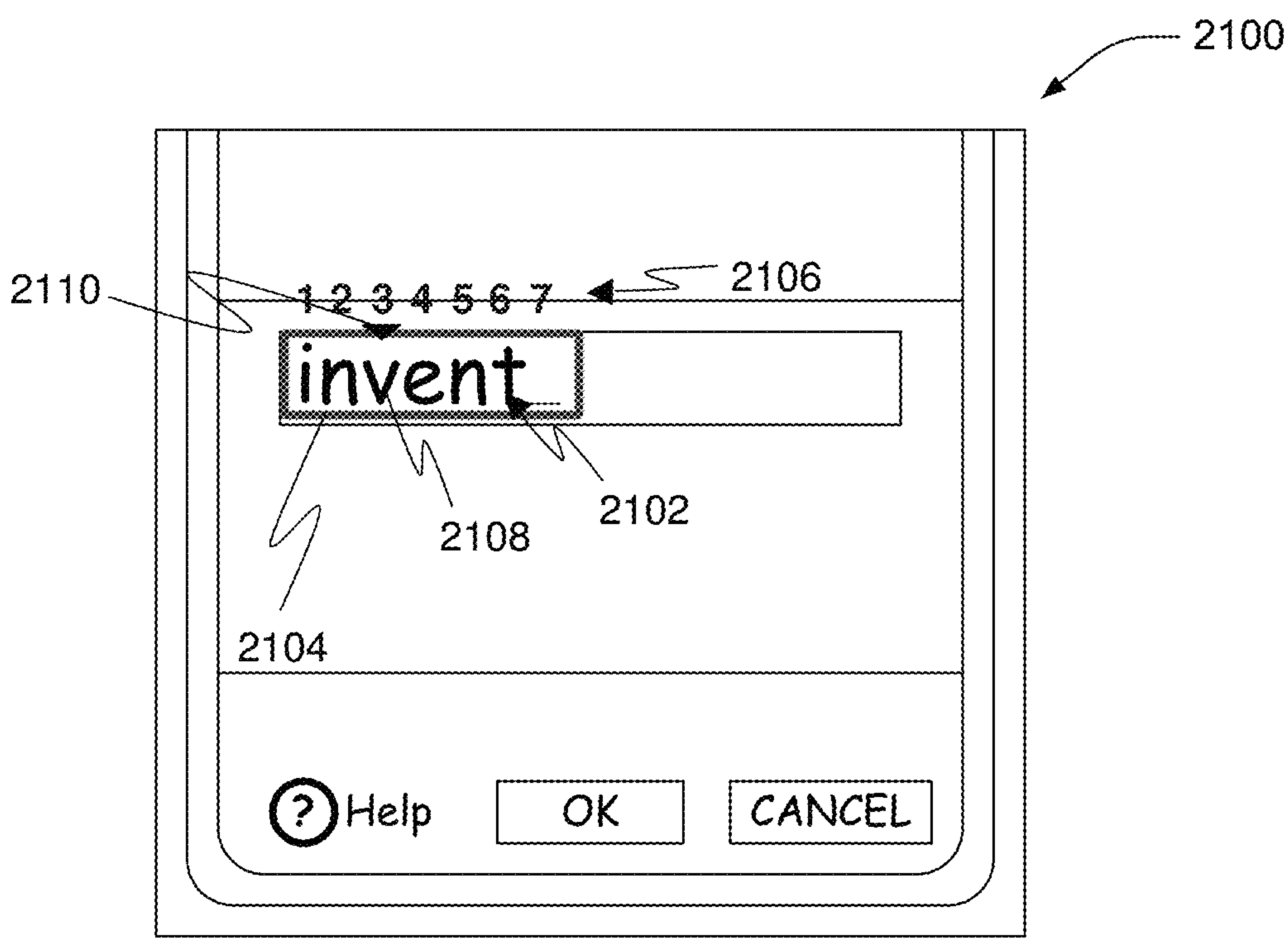
2100
2110
1 2 3 4 5 6 7
2106
invent_
2108
2102
2104
Help
OK
CANCEL

FIG. 21

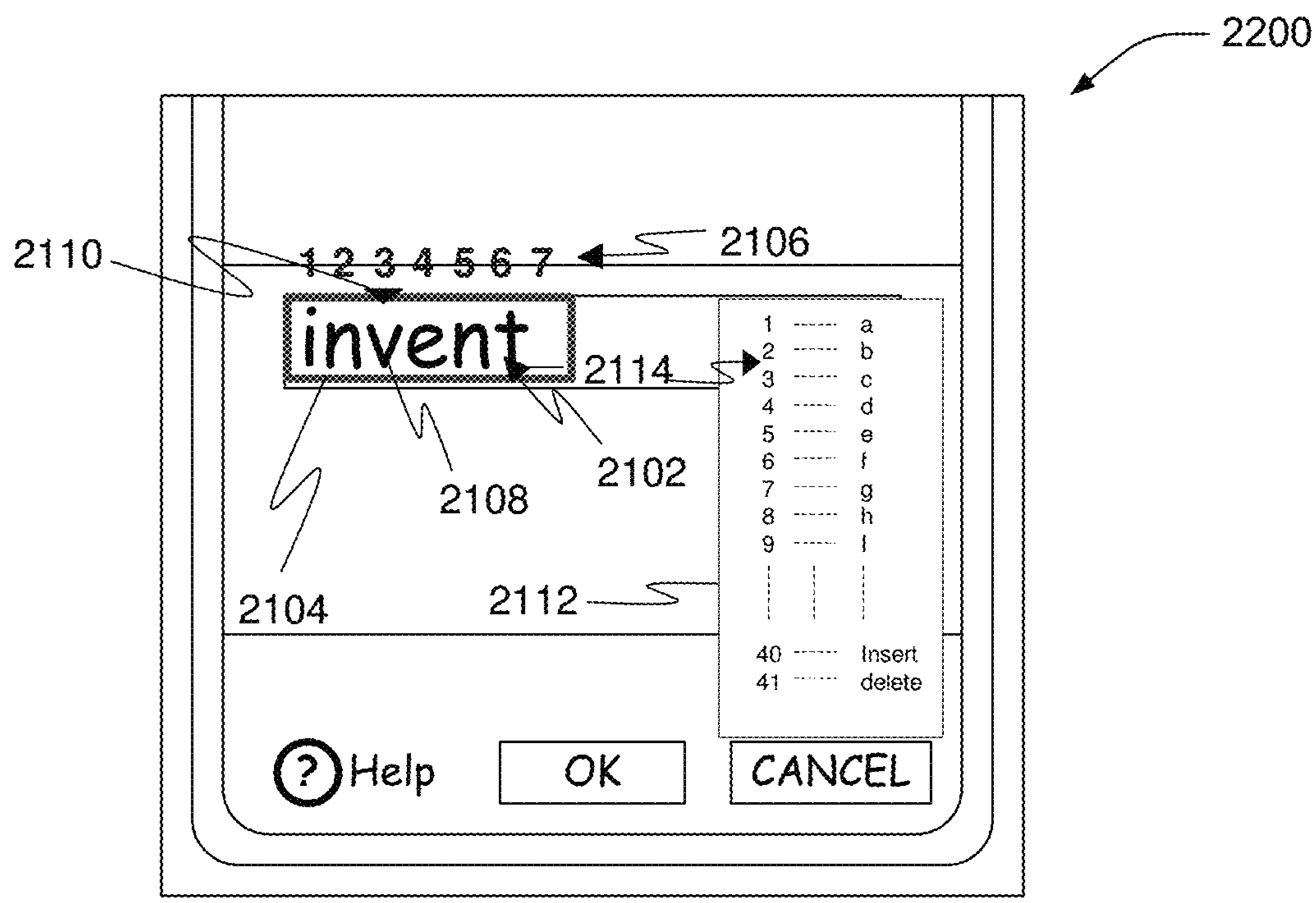
2200
2110
1 2 3 4 5 6 7
2106
invent
2114
1 a
2 b
3 c
4 d
5 e
6 f
7 g
8 h
9 i
40 Insert
41 delete
2108
2102
2104
2112
Help
OK
CANCEL

FIG. 22

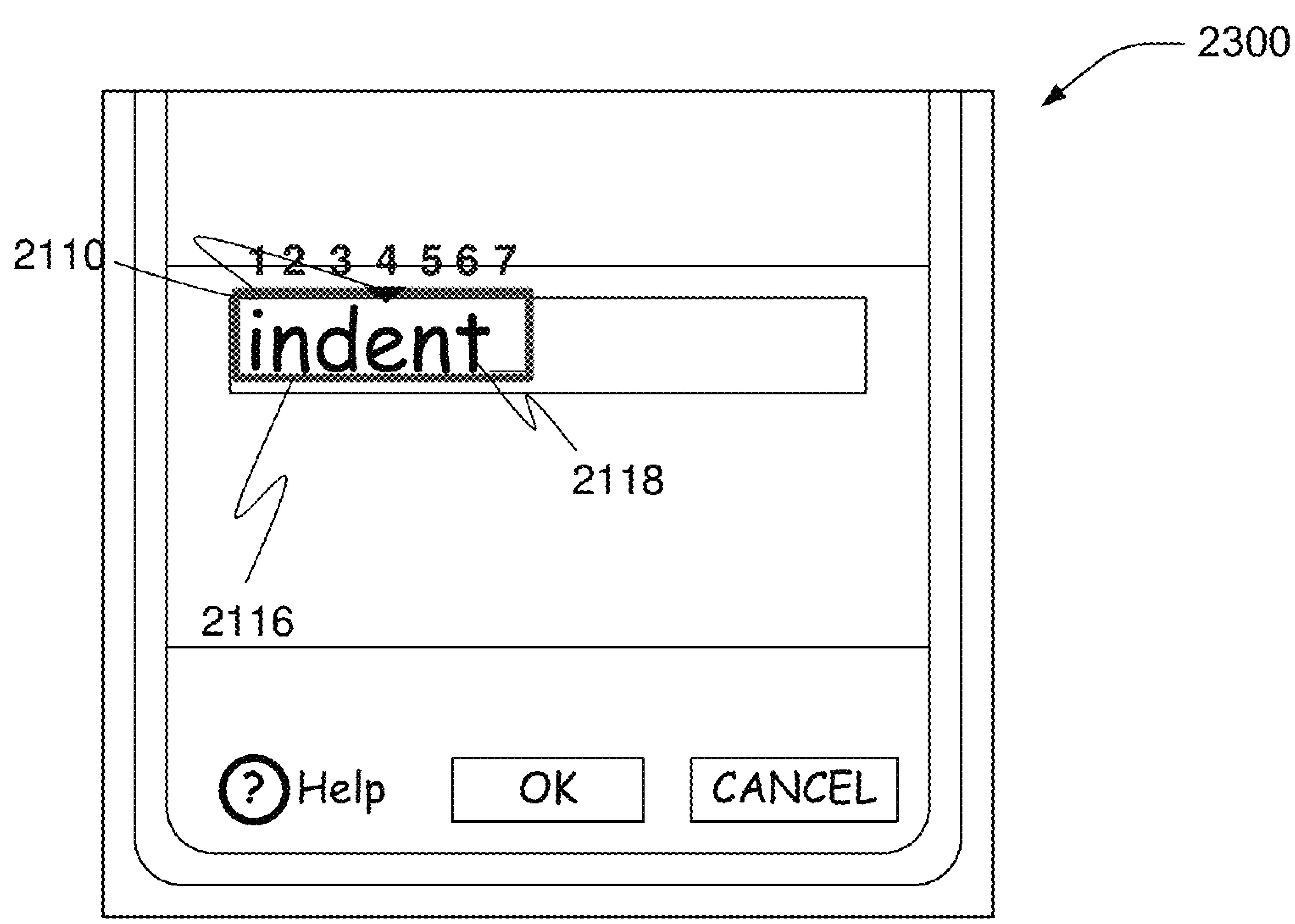
2300
2110
1 2 3 4 5 6 7
indent
2118
2116
Help
OK
CANCEL

FIG. 23

CENTRALIZED METHOD AND SYSTEM FOR DETERMINING VOICE COMMANDS

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application is a continuation of and claims priority of U.S. patent application Ser. No. 14/563,255, filed Dec. 8, 2014, which is a continuation of and claims priority of U.S. patent application Ser. No. 10/990,345, filed Nov. 16, 2004. The contents of these applications are hereby incorporated by reference in their entirety.

BACKGROUND

The present invention generally pertains to user interaction with a computing device. More specifically, the present invention pertains to user interactions with a centralized interface in the context of speech recognition.

Much attention, lately, has been directed towards the improvement of speech recognition technology. One such challenge in speech recognition technology lies in user interaction with a computing device using voice commands. Frequently, a voice command needs further clarification before the computing device can execute such a command.

A computing device can often interpret a voice command in multiple ways. In one aspect, a computing device may not understand which application the voice command is directed towards. For example, a voice command can include terms that are used across a plurality of application modules. In another aspect, an application may not understand what the user would like to execute because the voice command contains ambiguous information. For example, a voice command can include "play the Beatles" when there are multiple Beatles albums that the application could play. In still another example, the voice command can contain a misrecognition error. For example, the user may recite the command "insert ice cream" while the speech recognition system recognizes the command as "insert I scream".

Making guesses at what the user meant or taking action without consulting the user can lead to frustration for a user. There is a need to provide the user with the tools to control the clarification of voice commands and clarification of misrecognition errors without causing undue frustration and sacrificing speech recognition efficiency.

SUMMARY

A method and system is provided for facilitating centralized interaction with a user. The method and system includes providing a recognized voice command to a plurality of application modules. A plurality of interpretations of the voice command are generated by at least one of the plurality of application modules. A centralized interface module visually renders the plurality of interpretations of the voice command on a centralized display. An indication of selection of an interpretation is received from the user.

A centralized interface module that visually renders a list of interpretations to a user when there is otherwise ambiguity in a voice command avoids the arbitrary guessing of a command with which the user is referencing. In addition, a centralized display panel provided by a central interface module can allow generic user interaction.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a block diagram of a general computing environment in which the present invention can be practiced.

FIG. **2** illustrates a block diagram of a mobile device in which the present invention can be practiced.

FIG. **3** illustrates a block diagram of a system for facilitating centralized user interaction.

FIG. **4** illustrates an example screenshot of a centralized panel.

FIG. **5** illustrates an example screenshot of a centralized panel.

FIG. **6** illustrates an example screenshot of a display of a computing device.

FIG. **7** illustrates a flowchart of a method for facilitating centralized user interaction.

FIG. **8** illustrates an example screenshot of a centralized panel.

FIG. **9** illustrates an example screenshot of a centralized panel.

FIG. **10** illustrates an example screenshot of a centralized panel.

FIG. **11** is a block diagram illustrating a method for manipulating characters displayed on a centralized panel using a speech recognizer.

FIG. **12** illustrates an example screenshot of a centralized panel.

FIG. **13** illustrates an example screenshot of a centralized panel.

FIG. **14** illustrates an example screenshot of a centralized panel.

FIG. **15** illustrates an example screenshot of a centralized panel.

FIG. **16** illustrates an example screenshot of a centralized panel.

FIG. **17** illustrates an example screenshot of a centralized panel.

FIG. **18** illustrates an example screenshot of a centralized panel.

FIG. **19** illustrates an example screenshot of a centralized panel.

FIG. **20** illustrates an example screenshot of a centralized panel.

FIG. **21** illustrates an example screenshot of a centralized panel.

FIG. **22** illustrates an example screenshot of a centralized panel.

FIG. **23** illustrates an example screenshot of a centralized panel.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

The present invention is described in the context of a computer-implemented system which uses speech recognition to recognize voice commands from a user. Before describing aspects of the present invention, however, it may be useful to describe suitable computing environments that can incorporate and benefit from these aspects.

FIG. **1** illustrates an example of a suitable computing system environment **100** on which the invention may be implemented. The computing system environment **100** is only one example of a suitable computing environment and is not intended to suggest any limitation as to the scope of use or functionality of the invention. Neither should the computing environment **100** be interpreted as having any dependency or requirement relating to any one or combination of components illustrated in the exemplary operating environment **100**.

The invention is operational with numerous other general purpose or special purpose computing system environments or configurations. Examples of well-known computing systems, environments, and/or configurations that may be suitable for use with the invention include, but are not limited to, personal computers, server computers, hand-held or laptop devices, multiprocessor systems, microprocessor-based systems, set top boxes, programmable consumer electronics, network PCs, minicomputers, mainframe computers, telephony systems, distributed computing environments that include any of the above systems or devices, and the like.

The invention may be described in the general context of computer-executable instructions, such as program modules, being executed by a computer. Generally, program modules include routines, programs, objects, components, data structures, etc. that perform particular tasks or implement particular abstract data types. The invention may also be practiced in distributed computing environments where tasks are performed by remote processing devices that are linked through a communication network. In a distributed computing environment, program modules may be located in both local and remote computer storage media including memory storage devices. Tasks performed by the programs and modules are described below and with the aid of figures. Those skilled in the art can implement the description and figures provided herein as processor executable instructions, which can be written on any form of a computer readable medium.

With reference to FIG. **1**, an exemplary system for implementing the invention includes a general-purpose computing device in the form of a computer **110**. Components of computer **110** may include, but are not limited to, a processing unit **120**, a system memory **130**, and a system bus **121** that couples various system components including the system memory to the processing unit. System bus **121** may be any of several types of bus structures including a memory bus or memory controller, a peripheral bus, and a local bus using any of a variety of bus architectures. By way of example, and not limitation, such architectures include Industry Standard Architecture (ISA) bus, Micro Channel Architecture (MCA) bus, Enhanced ISA (EISA) bus, Video Electronics Standards Association (VESA) local bus, and Peripheral Component Interconnect (PCI) bus also known as Mezzanine bus.

Computer **110** typically includes a variety of computer readable media. Computer readable media can be any available media that can be accessed by computer **110** and includes both volatile and nonvolatile media, removable and non-removable media. By way of example, and not limitation, computer readable media may comprise computer storage media and communication media. Computer storage media includes both volatile and nonvolatile, removable and non-removable media implemented in any method or technology for storage of information such as computer readable instructions, data structures, program modules or other data. Computer storage media includes, but is not limited to, RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other optical disk storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to store the desired information and which can be accessed by computer **110**. Communication media typically embodies computer readable instructions, data structures, program modules or other data in a modulated data signal such as a carrier wave or other transport mechanism and includes any information delivery media. The term "modulated data signal" means a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media includes wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, RF, infrared and other wireless media. Combinations of any of the above should also be included within the scope of computer readable media.

The system memory **130** includes computer storage media in the form of volatile and/or nonvolatile memory such as read only memory (ROM) **131** and random access memory (RAM) **132**. A basic input/output system **133** (BIOS), containing the basic routines that help to transfer information between elements within computer **110**, such as during start-up, is typically stored in ROM **131**. RAM **132** typically contains data and/or program modules that are immediately accessible to and/or presently being operated on by processing unit **120**. By way of example, and not limitation, FIG. **1** illustrates operating system **134**, application programs **135**, other program modules **136**, and program data **137**.

The computer **110** may also include other removable/non-removable volatile/nonvolatile computer storage media. By way of example only, FIG. **1** illustrates a hard disk drive **141** that reads from or writes to non-removable, nonvolatile magnetic media, a magnetic disk drive **151** that reads from or writes to a removable, nonvolatile magnetic disk **152**, and an optical disk drive **155** that reads from or writes to a removable, nonvolatile optical disk **156** such as a CD ROM or other optical media. Other removable/non-removable, volatile/nonvolatile computer storage media that can be used in the exemplary operating environment include, but are not limited to, magnetic tape cassettes, flash memory cards, digital versatile disks, digital video tape, solid state RAM, solid state ROM, and the like. The hard disk drive **141** is typically connected to the system bus **121** through a non-removable memory interface such as interface **140**, and magnetic disk drive **151** and optical disk drive **155** are typically connected to the system bus **121** by a removable memory interface, such as interface **150**.

The drives and their associated computer storage media discussed above and illustrated in FIG. **1**, provide storage of computer readable instructions, data structures, program modules and other data for the computer **110**. In FIG. **1**, for example, hard disk drive **141** is illustrated as storing operating system **144**, application programs **145**, other program modules **146**, and program data **147**. Note that these components can either be the same as or different from operating system **134**, application programs **135**, other program modules **136**, and program data **137**. Operating system **144**, application programs **145**, other program modules **146**, and program data **147** are given different numbers here to illustrate that, at a minimum, they are different copies.

A user may enter commands and information into the computer **110** through input devices such as a keyboard **162**, a microphone **163**, and a pointing device **161**, such as a mouse, trackball or touch pad. Other input devices (not shown) may include a joystick, game pad, satellite dish, scanner, or the like. These and other input devices are often connected to the processing unit **120** through a user input interface **160** that is coupled to the system bus, but may be connected by other interface and bus structures, such as a parallel port, game port or a universal serial bus (USB). A monitor **191** or other type of display device is also connected to the system bus **121** via an interface, such as a video interface **190**. In addition to the monitor, computers may also include other peripheral output devices such as speakers **197** and printer **196**, which may be connected through an output peripheral interface **195**.

The computer **110** is operated in a networked environment using logical connections to one or more remote computers, such as a remote computer **180**. The remote computer **180** may be a personal computer, a hand-held device, a server, a router, a network PC, a peer device or other common network node, and typically includes many or all of the elements described above relative to the computer **110**. The logical connections depicted in FIG. **1** include a local area network (LAN) **171** and a wide area network (WAN) **173**, but may also include other networks. Such networking environments are commonplace in offices, enterprise-wide computer networks, Intranets and the Internet.

When used in a LAN networking environment, the computer **110** is connected to the LAN **171** through a network interface or adapter **170**. When used in a WAN networking environment, the computer **110** typically includes a modem **172** or other means for establishing communications over the WAN **173**, such as the Internet. The modem **172**, which may be internal or external, may be connected to the system bus **121** via the user input interface **160**, or other appropriate mechanism. In a networked environment, program modules depicted relative to the computer **110**, or portions thereof, may be stored in the remote memory storage device. By way of example, and not limitation, FIG. **1** illustrates remote application programs **185** as residing on remote computer **180**. It will be appreciated that the network connections shown are exemplary and other means of establishing a communications link between the computers may be used.

FIG. **2** is a block diagram of a mobile device **200**, which is another applicable computing environment. Mobile device **200** includes a microprocessor **202**, memory **204**, input/output (I/O) components **206**, and a communication interface **208** for communicating with remote computers or other mobile devices. In one embodiment, the aforementioned components are coupled for communication with one another over a suitable bus **210**.

Memory **204** is implemented as non-volatile electronic memory such as random access memory (RAM) with a battery back-up module (not shown) such that information stored in memory **204** is not lost when the general power to mobile device **200** is shut down. A portion of memory **204** is preferably allocated as addressable memory for program execution, while another portion of memory **204** is preferably used for storage, such as to simulate storage on a disk drive.

Memory **204** includes an operating system **212**, application programs **214** as well as an object store **216**. During operation, operating system **212** is preferably executed by processor **202** from memory **204**. Operating system **212**, in one preferred embodiment, is a WINDOWS® CE brand operating system commercially available from Microsoft Corporation. Operating system **212** is preferably designed for mobile devices, and implements database features that can be utilized by applications **214** through a set of exposed application programming interfaces and methods. The objects in object store **216** are maintained by applications **214** and operating system **212**, at least partially in response to calls to the exposed application programming interfaces and methods.

Communication interface **208** represents numerous devices and technologies that allow mobile device **200** to send and receive information. The devices include wired and wireless modems, satellite receivers and broadcast tuners to name a few. Mobile device **200** can also be directly connected to a computer to exchange data therewith. In such cases, communication interface **208** can be an infrared transceiver or a serial or parallel communication connection, all of which are capable of transmitting streaming information.

Input/output components **206** include a variety of input devices such as a touch-sensitive screen, buttons, rollers, and a microphone as well as a variety of output devices including an audio generator, a vibrating device, and a display. The devices listed above are by way of example and need not all be present on mobile device **200**. In addition, other input/output devices may be attached to or found with mobile device **200** within the scope of the present invention.

FIG. **3** illustrates a schematic block diagram of a computer-implemented system **300** in accordance with an embodiment of the present invention. System **300** can be incorporated into any of the previously discussed computing environments and includes a microphone **302**, an audio capture module **304**, a speech recognizer **306**, a plurality of installed application modules **310** and a centralized interface module **312**. Microphone **302** is configured to receive a voice command from a user. Audio capture module **304** is configured to capture the voice command received by microphone **302** and convey the processed voice command to a speech recognizer **306**.

To recognize a voice command, speech recognizer **306** accesses a grammar **308** containing a plurality of recognizable commands. A grammar generator module **309** is configured to generate grammar **308** based on input received from installed and operating application modules **310**. The input received from application modules **310** populate grammar **308** and are the executable commands with which the application modules can process and execute various actions. Thus, each recognizable command located in grammar **308** corresponds to a command that executes an action in one of the plurality of application modules **310**.

Grammar generator module **309** can also populate grammar **308** with alternative forms of various commands. These alternative forms of commands typically are received from application modules **310**. For example, if a user desires to play the Beatles on a computing device, the user should utter "play the Beatles". It is possible, however, that the user may instruct the computing device to "start the Beatles" instead of properly instructing the computing device to "play the Beatles", which would accomplish the same task.

In some embodiments, grammar generator module **309** is further configured to determine which of application modules **310** are operational at any given time. For example, grammar generator module **309** can determine that five application modules are running on the operating system. The operational application modules include two instances of a web browser, an email application, a word processing application and a spreadsheet application. When grammar generator module **309** generates grammar **308**, it compresses the commands such that only one set of commands for the web browsing application populate grammar **308**. Grammar generator **309**, however, retains the notion that there are two instances of the web browser that are operational. Therefore, grammar generator **309** realizes that ambiguity exists at the time of generating grammar **308**.

In other embodiments, grammar generator **309** does not retain the notion that there are two instances of the web browser that are operational. In this embodiment, centralized interface module **312** can perform a status check on the operation system to determine if different instances of the same application are operational and, thus, ambiguous.

After speech recognizer **306** recognizes the voice command, the recognized voice command is communicated to the plurality of application modules **310**. The recognized voice command can either be communicated to the plurality of application modules via centralized interface module **312** or by speech recognizer **306**. Regardless of the path of communication, the plurality of application modules **310** process the recognized voice command.

In accordance with one embodiment of the present invention, some or all of the application modules **310** determine that they can execute the recognized voice command. For example, a user utters the command “start settings”. However, many of the application modules **310** that are installed in system **300** could have application aspects that include the term “settings”. Therefore the recognized command **310** is ambiguous. It is unclear as to which application the user is referring.

In this embodiment, centralized interface module **312** gathers the set of possible interpretations of the recognized voice command from the plurality of application modules **310**. Centralized interface module **312** then visually renders the set of interpretations in a list. The list of interpretations are viewed by the user on a centralized panel of display **314**. An example screenshot **400** of a centralized panel visually rendering a list of possible interpretations **402** is illustrated in FIG. **4**.

In accordance with another embodiment of the present invention, only one of the plurality of application modules **310** determines that it can execute the recognized voice command. For example, a user utters the command “play the Indigo Girls”. Only one application module **310**, such as a media application, has a menu item that includes “play the Indigo Girls”. However, upon the media application attempting to execute the command, it discovers that there are four possible Indigo Girls albums that can be played. Therefore, the recognized command is ambiguous. It is unclear to the media application what album the user meant to play.

In this embodiment, centralized interface module **312** gathers the set of possible interpretations of the recognized voice command from the application module **310**. Centralized interface module **312** visually renders the set of interpretations in a list. The list of interpretations are viewed by the user in a centralized panel located on display **314**. Example screenshot **500** of a centralized panel visually renders a list of possible interpretations with reference to the described example is illustrated in FIG. **5**.

In accordance with yet another embodiment of the present invention and as previously discussed, there can be ambiguity in what instance or application module of a particular application the user is referencing. For example, a user is using a spreadsheet application and utters the command “switch to the Internet browser”. However, besides system **300** running one instance of the spreadsheet application, system **300** is also running two instances of the Internet browser application. Therefore, the recognized command is ambiguous. It is unclear which instance of the Internet browser the user is referring.

In this embodiment, speech recognizer **306** can supply centralized interface module **312** with a set of possible interpretations of the voice command based on grammar generator **309** retaining the notion that there are more than one instance of an operational web browser. In the alternative, centralized interface module **312**, after performing a status check of the operating system, can supply a set of possible interpretations of the voice command. Centralized interface module **312** visually renders the set of interpretations in a list. The list of interpretations are viewed by the user in a centralized panel located on display **314**.

Each interpretation in the list of interpretations **402** and **502** are annotated with an identifier (i.e. “1”, “2”, “3”, etc.). In the FIG. **4** and FIG. **5** embodiment, identifiers **404** and **504** are numeric symbols, although any form of symbol can be used. Upon viewing the list of interpretations **402** and **502**, the user can determine which of the interpretations is the interpretation that corresponds to what the user meant. In one embodiment, the user can select the correct command by speaking the corresponding numeric symbol. In another embodiment, the user can select the correct command by using an input device **316** (illustrated in FIG. **3**) to select desired interpretations. Input device **316** can be, but is not limited to, a selection apparatus, such as a mouse. Input device **316** can also be a keypad. Regardless of how the correct interpretation is selected, selection of an interpretation induces system **300** to execute the corresponding command by forwarding the command to the corresponding application.

In another embodiment, the user can indicate, in reference to FIG. **5**, that playing all of the Indigo Girls albums is desired. Communication line **506** indicates that the user can either select an interpretation from the plurality of interpretations **502** or the user can utter “Play all” to play all of the albums. Regardless of what the user desired, selection of the correct interpretation induces system **300** to take action by providing the command information to the corresponding application.

Using a centralized interface module that visually renders a list of interpretations to a user when there is otherwise ambiguity in a voice command provides a way for system **300** to avoid arbitrarily guessing an appropriate command. A centralized interface module also provides a simple centralized panel for graphically representing possible user interactions, provides a highly efficient means of determining what the user meant and provides a consistent interface that is located outside of the plurality of application modules. In other words, each of the screenshots of a centralized panel illustrated in FIGS. **4**, **5** and **8**-**10** (discussed below), look and operate similarly and can, therefore, be displayed in a consistent location. For example, FIG. **6** illustrates a screenshot **600** of a media player that is operating on an operating system. The user asks to “play Indigo Girls”. As discussed above, there is more than one album of Indigo Girls that could be played. The centralized interface or panel **500** appears in the lower right hand corner of the screen and prompts the user to select what the user meant. In this manner, the user is less confused as to how to operate with the display even though the centralized panel can be used with one or more application modules **310**.

FIG. **7** illustrates a flowchart **700** for providing a computer-implemented method of facilitating centralized interaction with a user. Flowchart **700** includes step **702** that entails receiving a voice command from a user. After receiving the voice command, flowchart **700** proceeds to step **704** to process the voice command such that it is in appropriate condition to be recognized by a speech recognizer. At step **706**, a speech recognizer, such as speech recognizer **306** of FIG. **3** recognizes the voice command. The speech recognizer compares the voice command to a plurality of commands stored in an index.

At step **708**, the recognized command is conveyed to a plurality of application modules. At step **710**, a plurality of interpretations are received upon at least one of the plurality of application modules determining that the recognized command is ambiguous. The plurality of interpretations are visually rendered to the user at step **712**. For example, the plurality of interpretations can be listed with a corresponding identifier on a centralized panel of a display. An indication of the user selection of one of the plurality of interpretations is received at step **714**. For example, by audibly indicating the identifier, the desired interpretation can be identified as the correct command.

In addition to clarifying voice commands by interacting with centralized interface module **312** in FIG. **3**, a user can also interact with centralized interface module **312** to correct recognition errors while the user is dictating to an application module, such as a word processing application. To correct recognition errors, the user can highlight a term that has been transcribed incorrectly by using an input device. After highlighting, the application module transmits a plurality of alternatives to centralized interface module **312**. The alternatives contain phrases that sound similar to the voice utterance. Centralized interface module **312** receives and visually renders the alternative phrases on the centralized panel of display **314**. Each of the alternative phrases includes a corresponding identifier. Centralized interface module **312** receives an indication of selection from the user via speech or input device **316** in the form of an identifier and conveys the selection to the application module.

In some instances, the centralized interface module **312** fails to visually render an alternative that is the correct alternative. Failure to render a correct alternative can occur if either speech recognizer **306** made a misrecognition error or if the alternative is not recognizable because the user has never used the utterance with system **300**. With these types of occurrences, centralized interface module **312** is configured to present further alternatives in addition to the alternatives previously presented. One such alternative includes presenting an option to respeak the original utterance. Another such further alternative includes presenting an option to allow the user to create a new alternative that is otherwise unfamiliar to system **300**.

For example, FIG. **8** illustrates a screenshot **800** of a centralized panel that is visually rendering a list of alternatives in accordance with an embodiment of the present invention. The list of alternatives include a list of alternative phrases **804** generated by a word processing application and a list of further alternatives **806** generated by centralized interface module **312**. Each of the further alternatives **806** includes a corresponding identifier such that the user can make an indication of selection in the form of an identifier.

If the user selects identifier "9", then the centralized interface module **312** visually renders a screenshot **900** in a centralized panel as illustrated in FIG. **9**. The communication line **902** of screenshot **900** prompts the user to respeak the utterance. Upon respeaking the utterance, centralized interface module **312** will visually render a refreshed list of alternatives. Selecting identifier "9" is useful if system **300** has made a recognition error. If the user selects the identifier "10" in FIG. **8**, then centralized interface module **312** visually renders screenshot **1000** in a centralized panel as illustrated in FIG. **10**. Communication line **1002** of screenshot **1000** prompts the user to spell the utterance aloud. As the user spells the utterance, the letters will appear in block **1004**. In addition, it is possible that a user could also type the correct spelling of the utterance in block **1004** using an input device.

In another embodiment of the present invention, FIG. **11** is a block diagram illustrating a method **1100** for manipulating characters displayed on a centralized panel, such as screenshot **1000** of a centralized panel illustrated in FIG. **10**, after the user audibly spells a new alternative. For example, in FIG. **12**, the user spells the following phrase, "intent". However, the speech recognizer **306** (FIG. **3**) has "heard" the series of entered text **1204** as "i", "n", "v", "e", "n", "t" and thus, displays the word "invent" on panel **1200**. The word "invent" needs to be corrected to be "intent."

Referring to FIG. **13**, in order to correct this, the user invokes a spelling command to vocally communicate a command to modify "invent". Upon the system **300** receiving the spelling command, the selected word is identified and an appended word **1302** is created by appending at least one space **1304** to the selected word, wherein the appended word **1302** includes at least one character **1306** to be modified, as shown in operational block **1102** (FIG. **11**). Each of the characters **1308** in the appended word are then assigned and correlated with a unique numerical value **1310**, as shown in operational block **1104**. The appended word **1302** is then displayed via screenshot **1300** of a centralized panel to visually communicate the correlation between each of the characters **1308** in the appended word **1302** and their assigned unique numerical value **1310**. This correlation may be visually communicated by drawing a box **1312** around the appended word **1302** on screenshot **1300** and displaying each of the unique numerical values **1310** adjacent their assigned character **1308** in the appended word **1302**. As such, each of the characters **1308** is "assigned" a unique numerical value **1310** to which each character **1308** is correlated. For example, a user who wants to change the word "invent" **1314** to "intent", would vocally enter a command to speech recognizer **306**. This would cause a box **1312** to be displayed on screenshot **1300** around the word "invent" **1314**. This also causes each letter in the word "invent" **1314** to be assigned a unique numerical value **1310** which is displayed adjacent its corresponding character **1308**, both of which is shown in FIG. **13**. This will allow the user to change and/or correct any letter in the word "invent."

At this point, a selection command and a modification command may be received by system **300**, wherein the selection command is the unique numerical value **1310** corresponding to a selected character, as shown in operational block **1106**. This indicates to system **300** which character in the appended word **1302** is to be changed. Once system **300** receives the modification command a modified word is generated by modifying the selected character responsive to the modification command, as shown in operational block **1108**. It should be appreciated that the user may enter in a plurality of modification commands, such as "delete", "insert", or the letter/character to be added, wherein each of these situations are discussed below.

For example, referring to FIG. **14**, consider the case above where the user would like to delete the letter "v" **1402** in the appended word "invent_" **1404** displayed on a screenshot **1400** of a centralized panel. As discussed herein, the user communicates the unique numerical value corresponding to the character to be change to system **300**. It should be appreciated that although these unique numerical values **1408** start with the number **1** and increase by 1, any unique numerical values **1408** and increments may be assigned. As can been seen, the letter "v" **1402** in the appended word "invent_" **1404** is assigned a unique numerical value **1408** of "3". As such, the user would vocally communicate the number "3" to system **300**. This selects the letter corresponding to and correlated with the number "3" as indicated by the caret **1410**, which in this case is the letter "v" **1402** in the appended word "invent" **1404**. The user may then enter the desired modification command, such as "delete" which will cause the letter "v" **1402** to be deleted from the appended word "invent" **1404**, leaving the resultant "inent" **1412**, as shown in screenshot **1500** of a centralized panel of FIG. **15**. Thus, the modification command "delete" will remove the selected letter and its corresponding space from the appended word and the selection caret **1410** will select the next subsequent character, i.e. "e."

On the other hand, referring to FIG. **16**, consider the case where the user wants to insert a character, such as a letter or space, between the letter "n" **1604** and the letter "v" **1606** in the word "invent" displayed on screenshot **1600** in a centralized panel. In essence, the user wants to insert a character into the spot corresponding to the unique numerical value "3". As discussed herein, the user may vocally communicate a command. This causes a space to be appended to the word "invent" to create an appended word "invent_" **1608** and a box **1610** to be displayed around the appended word "invent_" **1608** and unique numerical values **1612** to be assigned and displayed adjacent each of the characters in the appended word "invent_" **1608**. As can be seen, the letter "v" **1606** in the appended word "invent_" **1608** is assigned a unique numerical value **1612** of "3". As such, the user can vocally communicate the number "3" to system **300** to "select" the letter corresponding to and correlated with the number "3" as indicated by the caret **1614**, which in this case is the letter "v" **1606** in the appended word "invent_" **1608**. The user may then enter in a modification command, causing system **300** to respond in an appropriate manner. For example if the user communicates the modification command "insert" and then communicates the word "space", then a space will be inserted between the letter "n" **1604** and the letter "v" **1606**, effectively changing the appended word "invent_" **1608** to "in vent" **1616**, as shown in screenshot **1700** in a centralized panel illustrated in FIG. **17**. In this case the caret **1614** would remain in place to indicate that the space correlated with the unique numerical value "3" has been selected. However, if the user communicates the command "insert" and then communicates the letter "p", then the letter "p" will be inserted between the letter "n" **1604** and the letter "v" **1606**, effectively changing the appended word "invent_" to "inpvent_" **1618**, as shown in screenshot **1800** of a centralized panel illustrated in FIG. **18**, and the selection caret **1614** will shift to the following character to indicate that the following character (i.e. the character corresponding to the unique numerical value "4") has been selected.

Similarly, referring to FIG. **19**, consider the case where the user simply wants to change a letter in the word "invent" displayed on screenshot **1900** of a centralized panel. As discussed herein, the user may vocally communicate a command. This causes a space to be appended to the word "invent" to create an appended word "invent_" **1902** and a box **1904** to be displayed around the appended word "invent_" **1902** and unique numerical values **1906** to be assigned and displayed adjacent each of the characters **1908** in the appended word "invent_" **1902**. As can been seen, the letter "v" **1912** in the appended word "invent_" **1902** is assigned a unique numerical value **1906** of "3." As such, the user can vocally communicate the number "3" to system **300**. This causes the letter corresponding to and correlated with the number "3" to be selected as indicated by the caret **1910**, which in this case is the letter "v" **1912** in the appended word "invent_" **1902**. The user may then enter in a modification command (in this case the command is simply a letter) causing system **300** to respond in an appropriate manner. For example if the user communicates the modification command "t" after the number "3", then the letter "v" **1912** will be replaced with the letter "t", effectively changing the appended word "invent_" **1902** to the word "intent" **1914**, as shown in screenshot **2000** of a centralized panel illustrated in FIG. **20**. At this point the selection caret **1910** will shift to the following character to indicate that the following character (i.e. the character corresponding to the unique numerical value "4") has been selected.

It should be appreciated that once a user enters the unique numerical value corresponding to the letter to be changed, a menu of suggested modification commands may be displayed, such as a dropdown menu, where each suggested action would be assigned is own unique numerical value. For example, referring to FIG. **21**, consider the case where the user wants to change a letter in the word "invent" displayed on screenshot **2100** of a centralized panel. The user vocally communicates a command. This causes a space to be appended to the selected word "invent" to create an appended word "invent_" **2102** and a box **2104** to be displayed around the appended word "invent_" **2102** and unique numerical values **2106** to be displayed adjacent each of the letters in the appended word "invent_" **2102**. As can been seen, the letter "v" **2108** in the appended word "invent_" **2102** is assigned a unique numerical value **2106** of "3." As such, the user would vocally communicate the number "3" to system **300** to "select" the character corresponding to and correlated with the unique numerical value "3" as indicated by the caret **2110**, which in this case is the letter "v" **2108** in the appended word "invent_" **2102**. Referring to FIG. **22**, a menu **2112** may be displayed on centralized panel shot **2200** giving the user a number of modification command choices, each of which is assigned a second unique numerical value **2114**. The user may then enter a modification command which is the second unique numerical value **2114** correlated with the desired modification command causing the speech recognition software application to respond in an appropriate manner. For example, if the user communicates the numerical value "4" after the number "3" then the letter "v" **2108** will be replaced with the letter "d" **2116**, effectively changing the appended word "invent_" **2102** to the word "indent" **2118**, as shown in screenshot **2300** of a centralized panel in FIG. **23**. As above, the selection caret **2110** will shift to the following character to indicate that the following character (i.e. the character corresponding to the unique numerical value "4") has been selected.

It should be appreciated that the menu **2112** of suggested modification commands may include any modification commands suitable to the desired end purpose, such as a menu of characters/words that are acoustically similar to the selected letter or word, e.g. if "v" is selected, then the menu **2112** will contain "d", "t", "e", "g", "3". Additionally, the menu **1012** may also contain the capitalized form of the characters, e.g. "V", as well as an auto-complete list from a spell checker. As such, for this example the menu **1012** may include the words "indent", "intent", "amend." Furthermore, it should be appreciated that the present invention may include voice commands that performing multiple functions simultaneously, e.g. "Change 3 to "e" as in eagle," or "Change t to g" may change the letter "t" to the letter "g" if there were only one letter "t" in the selected word. If there were two letters "t" in the selected word, feedback may be provided to the user to be more precise. Moreover, other commands may also be provided such as "undo" which may revert previously changed characters to their previous state, e.g. if the user says "cap that" (to capitalize the selected letter), but the input is recognized as "caret", then the user may say "undo" to revert the letter to the previous state.

With reference to FIGS. **8-23**, these figures are discussed in the context of a user dictating to a word processing application. However, those skilled in the art will recognize that the embodiments discussed in FIGS. **8-23** can also apply to a user uttering a voice command to system **300**. If a voice command is ambiguous, centralized interface module **312** will visually render a list of interpretations and also visually render a list of further alternatives. The list of further alternatives include an alternative to respeak the command and an alternative to create a new command. For example, if the user would like to send email to David White, the user can audibly issue the command "insert the name David". However, if the user has previously sent email to David Black and David Green, but never has sent email to David White, there is an ambiguity as to what David to insert. Centralized interface module **312** visually renders a list of David interpretations. The list of interpretations includes David Black and David Green. In addition, centralized interface module **312** visually renders a list of further alternatives that includes an alternative to respeak the voice command and an alternative to create a new voice command. In this example, the user would choose to create a new command because the user desires to email David White, which is unfamiliar to system **300**.

In addition to clarifying commands and correcting misrecognition errors by interacting with a centralized interface module **312**, a user can also interact with centralized interface module **312** to receive feedback from the plurality of application modules **310**. Centralized interface module **312** is configured to visually render what system **300** is listening for. For example, the centralized panel can display that system **300** is listening for nothing because microphone **302** is turned off. In addition, centralized interface module **312** is also configured to visually render the status of system **300**. For example, the centralized panel can display the last command recognized by system **300**. In another embodiment, the centralized panel can display that a particular application module is opening or closing.

Although the present invention has been described with reference to particular embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention.

What is claimed is:

1. A method performed by a computing system, the method comprising:

receiving, by a grammar generator, a first input corresponding to a first application that is associated with the computing system,

the first input identifying a set of terms associated with a first executable command, that is executable to perform a corresponding application action in the first application;

receiving, by the grammar generator, a second input corresponding to a second application that is associated with the computing system,

the second input identifying a set of terms associated with a second executable command, that is executable to perform a corresponding application action in the second application;

based on the first and second inputs, generating, by the grammar generator, a grammar that is stored in a data store and includes grammar commands that correspond to the first and second executable commands;

in response to an indication of a first user speech input, accessing, by a module that is separate from the first and second applications, the grammar stored in the data store;

determining, by the module, a first correlation between terms in the first user speech input and a first one of the grammar commands that corresponds to the first executable command;

determining, by the module a second correlation between the terms in the first user speech input and a second one of the grammar commands that corresponds to the second executable command;

detecting an ambiguity based on the first and second correlations;

providing an output that represents the detected ambiguity;

receiving, in response to the output, an indication of a second user speech input;

based on the second user speech input, selecting, by the module, an executable command from the first executable command and the second executable command; and

generating an instruction that

launches one of the first application or the second application that corresponds to the selected executable command; and

performs the corresponding application action in the launched application.

2. The method of claim **1**, further comprising:

storing each grammar command in association with a corresponding one of the first or second applications.

3. The method of claim **1**, wherein the grammar commands include a set of grammar commands that correspond to alternative forms of the first executable command.

4. The method of claim **3**, wherein the alternative forms of the first executable grammar command have a same definition of the first executable command.

5. The method of claim **1**, and further comprising:

rendering an indication to a user that identifies at least the first executable command; and

based on the second user speech input,

selecting the first executable command; and

launching the first application to perform the corresponding application action in the first application.

6. The method of claim **5**, wherein the indication identifies the first application.

7. The method of claim **1**, wherein the terms are determined by a speech recognizer processing the first user speech input.

8. A computing system comprising:

at least one processor; and

memory storing instructions executable by the at least one processor, wherein the instructions, when executed, cause the computing system to:

receive an indication of a set of grammar commands for an application associated with the computing system, each grammar command corresponding to an executable command that is executable by the application to perform a corresponding application action; and

receive an indication of a first speech input, from a user, captured by a speech capture component;

determine a first correlation between terms in the first speech input and a first one of the grammar commands that corresponds to a first executable command;

determine a second correlation between terms in the first speech input and a second one of the grammar commands that corresponds to a second executable command;

detect an ambiguity based on the first and second correlations;

provide, to the user, an output that represents the detected ambiguity;

receive, in response to the output, an indication of a second speech input that is captured by the speech capture component and resolves the ambiguity; and

based on the second speech input, execute the executable command that corresponds to one of the grammar commands.

9. The computing system of claim **8**, wherein the corresponding one of the grammar commands is selected based at least in part on one or more terms identified from the second speech input.

10. The computing system of claim **8**, wherein the output includes an application identifier that is rendered to the user and identifies the application.

11. The computing system of claim **10**, wherein two or more of the plurality of grammar commands correspond to alternative forms of a particular one of the executable commands that have the same definition of the particular executable command.

12. The computing system of claim **8**, wherein the instructions, when executed, cause the computing system to launch the application to execute the selected executable command.

13. A computing system comprising:

at least one processor; and

memory storing instructions executable by the at least one processor, wherein the instructions, when executed, configure the computing system to:

receive, a first input corresponding to a first application that is associated with the computing system,

the first input identifying a set of terms associated with a first set of executable commands, each being executable by the first application to perform a corresponding application action;

receive a second input corresponding to a second application that is associated with the computing system,

the second input identifying a set of terms associated with a second set of executable commands, each being executable by the second application to perform a corresponding application action;

generate a grammar that is stored in a data store and includes a plurality of grammar commands based on the first and second inputs from the first and second applications, wherein each grammar command:

corresponds to one of the executable commands, and is stored in association with a respective one of the first or second applications;

based on a first user speech input from a user, access the grammar using a module that is separate from the first and second applications;

determine a first correlation between terms in the first user speech input and a first one of the grammar commands;

determine a second correlation between terms in the first user speech input and a second one of the grammar commands;

detect an ambiguity based on the first and second correlations;

provide an output that represents the detected ambiguity;

receive, in response to the output, an indication of a second user speech input;

based on the second user speech input, select one of the first or second grammar commands; and

generate an instruction that launches the application associated with the selected grammar command and executes the executable command corresponding to the selected grammar command.

14. The computing system method of claim **13**, wherein the selected grammar command is selected based on a correlation of the second user speech input to the grammar command.

15. The computing system method of claim **13**, wherein two or more of the plurality of grammar commands correspond to alternative forms of a particular one of the executable commands and have the same definition of the particular executable command.

16. The computing system method of claim **13**, wherein the output includes an indication of the first grammar command.

17. The computing system method of claim **16**, wherein the output comprises a prompt that identifies the first application.

18. The computing system method of claim **13**, wherein the instructions configure the computing system to:

define an operational instruction based at least in part on the selected executable command and a portion correlated to the first user speech input.

19. The computing system method of claim **13**, wherein the instructions configure the computing system to:

identify one or more executable commands that correspond to the first user speech input; and

determine that the first user speech input is ambiguous based on at least one of:

a determination that the one or more executable commands that can be executed to perform more than one action; or

a determination that the one or more executable commands can be executed by more than one of the applications.

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